AERONAUTICS BRANCH
DEPARTMENT OF COMMERCE

SERVICE MONOGRAPHS
OF THE
UNITED STATES GOVERNMENT
No. 61

INSTITUTE FOR GOVERNMENT RESEARCH
OF
THE BROOKINGS INSTITUTION

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THE AERONAUTICS BRANCH DEPARTMENT OF COMMERCE

ITS HISTORY, ACTIVITIES, AND ORGANIZATION

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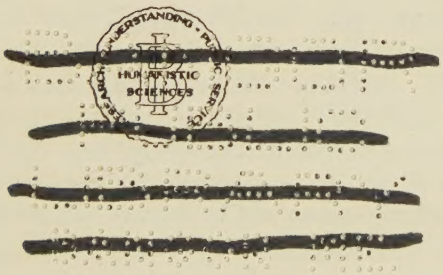
BY
LAURENCE F. SCHMECKEBIER



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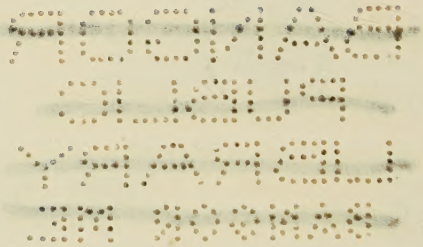

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FOREWORD

The first essential to efficient administration of any enterprise is full knowledge of its present make-up and operation. Without full and complete information before them, as to existing organization, personnel, plant, and methods of operation and control, neither legislators nor administrators can properly perform their functions.

The greater the work, the more varied the activities engaged in, and the more complex the organization employed, the more imperative becomes the necessity that this information shall be available—and available in such a form that it can readily be utilized.

Of all undertakings, none in the United States, and few, if any, in the world, approach in magnitude, complexity, and importance that of the national government of the United States. As President Taft expressed it in his message to Congress of January 17, 1912, in referring to the inquiry being made under his direction into the efficiency and economy of the methods of prosecuting public business, the activities of the national government "are almost as varied as those of the entire business world. The operations of the government affect the interest of every person living within the jurisdiction of the United States. Its organization embraces stations and centers of work located in every city and in many local subdivisions of the country. Its gross expenditures amount to billions annually. Including the personnel of the military and naval establishments, more than half a million persons are required to do the work imposed by law upon the executive branch of the government.

"This vast organization has never been studied in detail as one piece of administrative mechanism. Never have the foundations been laid for a thorough consideration of the relations of all of its parts. No comprehensive effort has been made to list its multifarious activities or to group them in such a way as to present a clear picture of what the

government is doing. Never has a complete description been given of the agencies through which these activities are performed. At no time has the attempt been made to study all of these activities and agencies with a view to the assignment of each activity to the agency best fitted for its performance, to the avoidance of duplication of plant and work, to the integration of all administrative agencies of the government, so far as may be practicable, into a unified organization for the most effective and economical dispatch of public business."

To lay the basis for such a comprehensive study of the organization and operations of the national government as President Taft outlined, the Institute for Government Research has undertaken the preparation of a series of monographs, of which the present study is one, giving a detailed description of each of the distinct services of the government. These studies are being vigorously prosecuted, and it is hoped that all services of the government will be covered in a comparatively brief space of time. Thereafter, revisions of the monographs will be made from time to time as need arises, to the end that they may, as far as practicable, represent current conditions.

These monographs are all prepared according to a uniform plan. They give: First, the history of the establishment and development of the service; second, its functions, described not in general terms, but by detailing its specific activities; third, its organization for the handling of these activities; fourth, the character of its plant; fifth, a compilation of, or reference to, the laws and regulations governing its operations; sixth, financial statements showing its appropriations, expenditures and other data for a period of years; and finally, a full bibliography of the sources of information, official and private, bearing on the service and its operations.

In the preparation of these monographs the Institute has kept steadily in mind the aim to produce documents that will be of direct value and assistance in the administration of public affairs. To executive officials they offer valuable tools of administration. Through them, such officers can,

with a minimum of effort, inform themselves regarding the details, not only of their own services but of others with whose facilities, activities, and methods it is desirable that they should be familiar. Under present conditions services frequently engage in activities in ignorance of the fact that the work projected has already been done, or is in process of execution by other services. Many cases exist where one service could make effective use of the organization, plant or results of other services had they knowledge that such facilities were in existence. With the constant shifting of directing personnel that takes place in the administrative branch of the national government, the existence of means by which incoming officials may thus readily secure information regarding their own and other services is a matter of great importance.

To members of Congress the monograph should prove of no less value. At present these officials are called upon to legislate and appropriate money for services concerning whose needs and real problems they can secure but imperfect information. That the possession by each member of a set of monographs such as is here projected, prepared according to a uniform plan, will be a great aid to intelligent legislation and appropriation of funds can hardly be questioned.

To the public, finally, these monographs will give that knowledge of the organization and operations of their government which must be had if an enlightened public opinion is to be brought to bear upon the conduct of governmental affairs.

These studies are wholly descriptive in character. No attempt is made in them to subject the conditions described to criticisms, nor to indicate features in respect to which changes might with advantage be made. Upon administrators themselves falls responsibility for making or proposing changes which will result in the improvement of methods of administration. The primary aim of outside agencies should be to emphasize this responsibility and facilitate its fulfillment.

While the monographs thus make no direct recommendations for improvement, they cannot fail greatly to stimulate efforts in that direction. Prepared as they are according to a uniform plan, and setting forth as they do the activities, plant, organization, personnel and laws governing the several services of the government, they will automatically, as it were, reveal, for example, the extent to which work in the same field is being performed by different services, and thus furnish the information that is essential to a consideration of the great question of the better distribution and co-ordination of activities among the several departments, establishments, and bureaus, and the elimination of duplication of plant, organization and work. Through them it will also be possible to subject any particular feature of the administrative work of the government to exhaustive study, to determine, for example, what facilities, in the way of laboratories and other plant and equipment, exist for the prosecution of any line of work and where those facilities are located or what work is being done in any field of administration or research, such as the promotion, protection and regulation of the maritime interests of the country, the planning and execution of works of an engineering character, or the collection, compilation and publication of statistical data, or what differences of practice prevail in respect to organization, classification, appointment, and promotion of personnel.

To recapitulate, the monographs will serve the double purpose of furnishing an essential tool for efficient legislation, administration and popular control, and of laying the basis for critical and constructive work on the part of those upon whom responsibility for such work primarily rests.

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THE AERONAUTICS BRANCH
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DEPARTMENT OF COMMERCE

ITS HISTORY, ACTIVITIES, AND ORGANIZATION

CHAPTER I

HISTORY

The Aeronautics Branch of the Department of Commerce is the unit which deals with the licensing of commercial aviators and aircraft, the registration and inspection of commercial aircraft, the development of airways, and researches in aeronautical problems. In general its powers and duties in regard to commercial aviation correspond roughly to those in relation to water craft exercised by the Steamboat Inspection Service, the Bureau of Lighthouses, and the Bureau of Navigation of the Department of Commerce. Its research work, however, is an activity not carried on by the three bureaus mentioned.

The Aeronautics Branch is not an operating service, although it has a small fleet of planes to facilitate its work. The Army (Air Crops) and the Navy (Bureau of Aeronautics) are the principal government operating services, and a small fleet is attached to the Coast Guard of the Treasury Department. In the civilian branch of the Government the Post Office Department has the greatest interest in operation by reason of the air-mail service, but it ceased to operate planes on September 1, 1927, since which date all air mail has been carried by private enterprises under contract.

The National Advisory Committee for Aeronautics is a purely governmental research organization established for

the purpose of the study of problems connected with the development of the science and art of aeronautics. Its facilities are available to all government departments, and also to such individuals and organizations as may defray the cost of desired investigations.

The Aeronautical Board is a joint board of the Army and the Navy which studies matters which affect both these services. It was organized in October, 1916, under the name of the Joint Army and Navy Board for the Consideration of the Development of a Zeppelin Service. On January, 24, 1919, it became the Joint Army and Navy Board on Aeronautics, and on December 29, 1919, it was given its present title.

Among the duties of the Board are the prevention of competition between the Army and the Navy in matters of procurement, the consideration of projects for experimental stations, and the revision of estimates of appropriations submitted by the two combat services.

Pre-regulation Period, 1903 to 1926. It is a little more than a a quarter of a century since Wilbur and Orville Wright made the first successful flight in a heavier-than-air machine at Kitty Hawk, North Carolina, on December 17, 1903. A lighter-than-air dirigible airship had been developed to a fair degree several years earlier, but owing to the higher cost of construction and greater difficulty in landing, the use of the airship has been far behind that of the heavier-than-air machines.

In December, 1907, the Government of the United States first formally entered the field of heavier-than-air aeronautics by requesting bids for the delivery of planes.[1] The aviation work of the Army was at this time under the Signal Service. In the early years the appropriation act made no reference to aviation, the total appropriation for the general expenses of the Signal Service being only $250,000 for the fiscal year 1911 (36 Stat. L., 245). In the next year the appropriation was increased to $375,000, with the proviso

[1] War Department, Annual Report, 1908, Vol. II, p. 211.

that not more than $125,000 might be expended for airplanes (36 Stat. L., 1038).

For the fiscal year 1912 the Navy Department also had an appropriation of $25,000 for "experimental work in the development of aviation for naval purposes" (36 Stat. L., 1268).

The first dispatch of mail by air took place in September, 1911, and in his report for 1911 the Postmaster General expressed the hope that "ultimately the regular conveyance of mail by this means may be practicable."[2] By June 30, 1912, mail had been carried over 50 temporary routes without cost to the Government.[3]

The next step was the creation of the National Advisory Committee for Aeronautics by the Navy Department appropriation act of March 3, 1915 (38 Stat. L., 930). This Committee, which is really an independent establishment of the Government for conduct of research in the field of aeronautics, originally had a membership of 12, as follows: Two members each from the War and Navy Departments, from the offices in charge of military and naval aeronautics; one each from the Smithsonian Institution, the Weather Bureau, and the Bureau of Standards, and five additional persons who "shall be acquainted with the needs of aeronautical science, either civil or military, or skilled in aeronautical engineering or its allied sciences." By the act of March 2, 1929 (45 Stat. L., 1451), the membership was increased to 15, the three additional members to have the same qualifications as the five who were not in the Government service.

The National Advisory Committee has no administrative functions, but has confined its activities to the field specified in its organic act; namely, "to supervise and direct the scientific study of the problems of flight, with a view to their practical solution, and to determine the problems which should be experimentally attacked, and to discuss their solution and their application to practical questions."

The carriage of mail on temporary routes without cost

[2] Postmaster General, Annual Report, 1911, p. 14.
[3] *Ibid.*, 1912, p. 142.

to the Government was continued during the fiscal years 1913 to 1916, and in 1916 bids were requested for the operation of one air-mail route in Massachusetts and several in Alaska, but none was received. For these years and for the fiscal year 1917 the Post Office Department had submitted an estimate for an appropriation for experimental services, but no funds for this purpose were forthcoming, although for the fiscal year 1917 the appropriation for inland transportation of mail "by steamboats and other power boat routes" also allowed transportation by airplanes. For the fiscal year 1918 the Postmaster General was allowed to expend not exceeding $100,000 for the purchase, operation, and maintenance of airplanes for an experimental airplane mail service between points to be selected by him. Thereafter appropriations were made regularly for the transportation of mail by air.

The World War gave a great stimulus to aviation in Europe, but had little effect on developments in America until the United States became a participant. An expansion of the flying force in the military service immediately took place, with the two-fold effect of expanding the manufacturing industry and of training a great number of pilots.

Regular transportation of mail by airplane began on May 15, 1918, between Washington and New York, the personnel and equipment at first being furnished by the War Department. In August the entire operation was taken over by the Post Office Department.[4] In 1919 the New York to Chicago route was placed in operation. At the beginning this was not a continuous airplane route; westbound the mail was carried by plane from New York to Cleveland and then placed on the train; eastbound the planes carried mail from Chicago to Cleveland, where transfer was made to the train for New York.

The Air Mail Service was further extended in 1920 both by government operation and by contract with commercial concerns. In that year the transcontinental air mail to San Francisco was placed in operation on the same plan as the Chicago-Cleveland route, the mail being carried by plane

[4] *Ibid.*, 1918, p. 16.

during the day and transferred to trains for movement during the night.[5]

By 1922 the Air Mail Service had been restricted, and the only service in operation was the transcontinental route, which was still operated as part air and part rail; the service continued in this status until July 1, 1924. In the meantime the Post Office Department had been experimenting with night flying, and had provided lights on the route between New York and Rock Springs, Wyo., a distance of 1,886 miles, at a cost of $514,405.68.[6] This was probably the first lighted airway in the world, and the installation of the equipment marks the beginning of the work of airway lighting now being done by the Aeronautics Branch of the Department of Commerce.

While the mail was carried the entire distance by plane after July 1, 1924, it did not move continuously. It was necessary for the plane to lie over during the night, for the airway was not lighted west of Rock Springs, Wyoming. The lighting of the airway was completed to Salt Lake City during the fiscal year 1926, but the lighting of the route from Salt Lake City to San Francisco was not completed until the early spring of 1929, the work on this section having been done by the Aeronautics Branch.

The carrying of mail by contract at a rate not exceeding four-fifths of the revenue was authorized by the act of February 2, 1925 (43 Stat. L., 805). This resulted in the expansion of the service. When the Aeronautics Branch was organized in 1926 the Post Office Department turned over to the new organization the lighting and maintenance of airways.

The amendatory act of June 3, 1926 (44 Stat. L., 692), authorized contracts for carrying the mail at pound rates. After this legislation the Government gave up the operation of the air mail which, after September 1, 1927, was carried entirely under contract by commercial companies.[7] Since

[5] *Ibid.*, 1920, p. 58.
[6] *Ibid.*, 1926, p. 29.
[7] *Ibid.*, 1927, p. 22.

that date mail transported by air has been on the same basis as that carried on land and water. The mail is delivered in sacks to the contractor, who may be a railroad, a bus line, a steamboat line, or an air carrier.

Movement for Regulation. In the beginning air travel, like other means of transportation, was not subject to governmental regulation, and airways were not marked or charted. As early as 1911 Judge Simeon E. Baldwin had suggested to the American Bar Association that action be taken looking to the formulation of the law of aviation.[8] Judge Baldwin's interest apparently was confined to property rights in the air, and did not contemplate licensing. Probably the first demand for supervision was an editorial in "Aeronautics" for March, 1912, stressing the desirability of Federal registration and licensing.[9]

The first government licensing was put into effect by the President's proclamation of February 28, 1918 (40 Stat. L., 1753), but this was purely a military measure resulting from the war and involved no regulations as to safety. The licensing was placed in the hands of the Joint Army and Navy Board on Aeronautic Cognizance. The licensing requirements were revoked by the proclamation of July 31, 1919 (41 Stat. L., 1765).

In 1918 the National Advisory Committee for Aeronautics recommended Federal legislation governing the licensing of pilots, the inspection of machines, and the use of landing fields,[10] and in the following year it drafted a bill placing these duties in the Department of Commerce. The recommendations of 1919 were submitted to Congress by the President,[11] but no legislation resulted at that time.

During the war and for some years thereafter, numerous hearings or investigations were held by regular committees of Congress, by special committees, and by the President's Aircraft Board. Most of these hearings dealt with aviation

[8] American Bar Association, Report, 1921, p. 78.
[9] *Aeronautics*, Vol. IV, March, 1912, p. 82.
[10] National Advisory Committee for Aeronautics, Report, 1918, p. 27.
[11] 65 Cong. 3 sess., H. doc. 1828.

as a part of the national defense, and considered civil aviation only as incidental to that subject. Just prior to the passage of the Air Commerce Act of 1926 hearings were held, dealing solely with civil aviation.[12]

The point at issue regarding military and naval aviation centered on questions of administration, efficiency, and whether aviation activities of the Army and the Navy should be placed under unified control. There was practically no opposition to the regulation of civil aviation, the delay in enacting legislation being due mainly to inertia and the pressure of other business before Congress.

As early as 1917 a bill[13] was introduced to create a department of aeronautics, which was to embrace only military and naval aeronautics and to have no civil powers. This bill was never reported from committee. In 1918 a similar bill[14] was favorably reported in the Senate, but no further action was taken. In 1919 a bill for a department of aeronautics[15] also provided for a military and naval operating service, but there was reported a substitute[16] which provided for regulation and development. This bill was later recommitted and no action resulted.

In 1920 and 1921 bills were introduced for a bureau of aeronautics to regulate and license civilian aviation.[17] In 1922 a substitute Senate bill[18] was passed by the Senate. No action was taken on the House bills.

In the meantime some of the States had enacted legislation, probably the first regulatory statute being an Oregon act of 1921, which required registration of pilots after examination.[19] By the end of 1921 laws regulating flying or requiring licenses had been passed by four States.[20] By

[12] For list of hearings see page 142.
[13] 65 Cong., S. 80.
[14] 65 Cong., S. 4852.
[15] 66 Cong., S. 2693.
[16] 66 Cong., S. 3348.
[17] 66 Cong., H. R. 14061 and 14137; 67 Cong., S. 2815.
[18] 67 Cong., S. 3076.
[19] Laws, 1921, c. 45.
[20] California, Kansas, Minnesota, and Oregon.

the end of 1925 similar laws had been enacted by thirteen other States [21] and the Territory of Hawaii.

In 1921 the National Advisory Committee for Aeronautics made a special report at the request of the President, and again recommended the creation of a bureau of aeronautics in the Department of Commerce. This report was transmitted to Congress by the President, who expressed his approval of the recommendations.[22]

In 1923 a House bill [23] was introduced, but was not reported from committee.

In 1923 another bill for a bureau of civil aeronautics [24] was introduced in the Senate. This bill passed the Senate in 1924 and was favorably reported to the House in 1925, but no further action was taken.

In 1923 a bill for the regulation of civil aeronautics [25] was considered by the House Committee on Interstate and Foreign Commerce, and as a result of its work a new bill [26] was introduced late in 1924.

By 1925 the controversy over aircraft in national defense had become so acute that the President, at the joint request of the Acting Secretary of War and the Secretary of the Navy, appointed a special board, known as the President's Aircraft Board for the "purpose of making a study of the best means of developing and applying aircraft in national defense, and to supplement the studies already made by the War and Navy Department." [27]

This Board consisted of Dwight W. Morrow, a banker; Major General James G. Harbord, United States Marine Corps, retired, President of the Radio Corporation of

[21] Connecticut, Delaware, Idaho, Maine, Massachusetts, Michigan, Nevada, North Dakota, South Dakota, Tennessee, Utah, Vermont, and Wisconsin.

Citations to the laws and brief statements regarding main provisions are given in Civil Aviation, 1926, pp. 112-13.

[22] 67 Cong., 1 sess., H. doc. 17.

[23] 67 Cong., H. R. 13715.

[24] 68 Cong., S. 76.

[25] 68 Cong., H. R. 3243.

[26] 68 Cong., H. R. 10522.

[27] 69 Cong., 1 sess., S. doc. 18, p. 1.

America; Rear Admiral Frank F. Fletcher, retired; Senator Hiram Bingham, Representatives Carl Vinson and James S. Parker, United States District Judge Arthur C. Denison, William F. Durand, Professor Emeritus of Mechanical Engineering at Stanford University and a member of the National Advisory Committee for Aeronautics, and Howard E. Coffin, a manufacturer of airplanes.

It took voluminous testimony, most of which was devoted to the military and naval aspects of aviation. In its report, among other recommendations, it advocated the separation of military and civil aviation, the creation of a civilian bureau of air navigation, and the appointment of three additional assistant secretaries of War, Navy, and Commerce to have supervision, respectively, over the activities of the Government in military, naval, and civil aeronautics.[28] In 1926 all these recommendations were put into effect.

About the same time a select committee of the House of Representatives conducted an inquiry into the operations of the air services. This inquiry was also concerned primarily with the combat aspect of aviation, but the committee recommended the establishment of a bureau of air navigation in the Department of Commerce.[29]

Finally, in 1926, a bill[30] passed both houses and became the Air Commerce Act of 1926. At the same session laws were enacted for developing the aviation services in the Army and Navy, and for placing air-mail transportation on a pound basis.

Legislation in 1926. Four acts passed in 1926 and of moment in the development of aeronautics were the following:

May 20. Air Commerce Act of 1926 (44 Stat. L., 568).
June 3. Amendment to Air Mail Act of 1925 (44 Stat. L., 692).
June 24. Navy Aircraft Act (44 Stat. L., 764).
July 2. Army Air Corps Act (44 Stat. L., 780).

[28] *Ibid.*, pp. 6, 10.
[29] 68 Cong., 2 sess., H. rept. 1653.
[30] 69 Cong., S. 41.

Air Commerce Act. The objects sought by the Air Commerce Act were as follows:

1. The promotion of air commerce.
2. The regulation of air commerce.
3. Establishment and maintenance of aids to air navigation.
4. Assertion of the sovereignty of the United States to the air over its lands and waters.
5. Application of customs, navigation, and immigration laws to aircraft.

The administration of the act was placed in the hands of the Secretary of Commerce, and in order to aid him there was provided an additional Assistant Secretary of Commerce, to be appointed by the President by and with the advice and consent of the Senate.

In the promotion of air commerce the following duties were recognized by the act:

1. Encouragement of the establishment of airports, civil airways, and other navigation facilities.
2. Making of recommendations to the Secretary of Agriculture as to necessary meteorological service.
3. Study of the possibilities of the development of air commerce and the aeronautical industry and trade, and the collection and dissemination of information on these subjects.
4. To advise with the Bureau of Standards and other agencies of the executive branch of the Government regarding research and development work for the creation of improved air navigation facilities, the Secretary being expressly authorized to transfer funds for research work.
5. Investigation of causes of accidents in civil air navigation and the recording and publication of data relating thereto.
6. Exchange of information with foreign governments on matters connected with civil air navigation.

The regulatory powers include the following:

1. Registration of aircraft, if requested by the owner.
2. Rating of aircraft as to airworthiness.
3. Periodic examination and rating of airmen in order to determine their qualifications.
4. Examination and rating of air navigation facilities in order to determine their suitability for such use.

5. Making regulations for the navigation, protection and identification of aircraft.
6. To provide for the issuance, suspension, and revocation of registration, aircraft, and airman certificates.

In the maintenance of aids to air navigation the Secretary is given the following powers:

1. To take over from the Post Office Department the airways, emergency landing fields, and other air navigation facilities (except airports and terminal landing fields).
2. To designate and establish civil airways, to operate air navigation facilities, except airports, and to chart airways and publish maps.

The act also provides that airports and landing fields owned by the United States may be made available for public use in the discretion of the head of the department having control of them. Government officers in charge of airports and landing fields are also authorized to furnish at fair market price, fuel, oil, equipment, supplies, mechanical services, and shelter. The portion of the proceeds received from such sales and services as is equivalent to the cost may be credited to the appropriation, and any excess over cost is to be credited to the miscellaneous receipts of the United States.

In order to provide additional information regarding weather conditions the Chief of the Weather Bureau is given specific authority to furnish data and make forecasts that will be of value to air navigation.

By joint resolution of July 3, 1926 (44 Stat. L., 915), the Secretary of War was authorized to detail officers of the Air Corps of the Army for duty under the Secretary of Commerce in connection with the promotion of civil aviation.

The act of February 28, 1929 (45 Stat. L., 1404), amended the act of 1926, and provided that the Secretary of Commerce should provide for the examination and rating of civilian schools giving instruction in flying, but only at the request of the owners or representatives of the schools.

Amendment of Air Mail Act. The amendment of June 3, 1926 (44 Stat. L., 692), to the Air Mail Act of 1925 (43 Stat. L., 805), had no direct effect on aviation development. The

simplifying of the method of computing payment to contractors for transportation resulted in quicker handling, and probably thereby interest in air mail and air transportation was stimulated.

Navy Air Act. The Navy Air Act of June 24, 1926 (44 Stat. L., 764), was an act relating entirely to the naval service, but it contained items of interest to the industry in that it laid down a definite plan of procurement for each of the fiscal years from 1927 to 1931 and for each year thereafter. It also provided for the appointment of an additional Assistant Secretary of the Navy to supervise naval aeronautics and to co-ordinate the activities of the Navy Department with those of other government agencies.

Army Air Act. The Army Air Act of July 2, 1926 (44 Stat. L., 780), contained not only provisions regarding the administration of the air service of the Army and a five-year program, but also legislation affecting procurement by both the Army and the Navy.

The Air Corps of the Army was definitely created as the air arm of the service. Provision was also made for an additional Assistant Secretary of War to aid the Secretary in fostering military aeronautics. The creation of this office carried out one of the recommendations of the President's Aircraft Board, and there were thus three assistant secretaries dealing with civil, military, and naval aeronautics.

The Army Air Act did not have any immediate effect on civil aeronautics, but it was of interest to the industry in that it laid down definite lines of procedure to be followed by both the Army and the Navy in purchasing aircraft without competitive bidding.

There was also created by this act the Patents and Design Board, consisting of an Assistant Secretary of War, an Assistant Secretary of the Navy, and an Assistant Secretary of Commerce. The law does not specify that the assistant secretaries of these departments in charge of aeronautics shall be members of this Board, but such was evidently the intention, and these officers have served in that capacity.

To this Board may be submitted any design for aircraft or for parts and accessories, whether patentable or

unpatentable. The Board submits the design to the National Advisory Committee for Aeronautics for recommendation. Under the amendatory act of March 3, 1927 (44 Stat. L., 1380), if the Committee makes a favorable recommendation, the Board then determines whether the use of the design by the Government is necessary or desirable, and evaluates it and fixes its worth at an amount not to exceed $75,000. The sum fixed by the Board is then offered to the designer for an assignment or nonexclusive license to the United States.

Regulation and Promotion, 1926 to 1929. The Air Commerce Act was approved May 20, 1926, but no money was available for expenditure prior to July 1, 1926. An estimate for the fiscal year ending June 30, 1927, was promptly submitted, and the deficiency act of July 3, 1926 (44 Stat. L., 853), appropriated $250,000 for general expenses, mostly salaries, and $300,000 for aids to air navigation, mostly equipment and structures. The appropriation act for the fiscal year 1928, approved February 24, 1927 (44 Stat. L., 1200), made available for the fiscal year 1927 the additional sums of $168,000 for general expenses and $450,000 for aids to air navigation out of the appropriation for the fiscal year 1928.

The deficiency act of July 3, 1926 (44 Stat. L., 850), carried also an additional appropriation of $75,000 for the Weather Bureau of the Department of Agriculture for the fiscal year 1927 for observing, measuring, and investigating atmospheric phenomena. This appropriation was not expended by the Department of Commerce, but it arose from the passage of the Air Commerce Act.

The Assistant Secretary of Commerce in charge of Aeronautics qualified on August 11, 1926, and the organization of the new work proceeded rapidly after that date. Five divisions were organized to carry on the work, three being parts of existing bureaus of the Department. The construction and maintenance of airways (Airways Division) was placed in the Bureau of Lighthouses, the mapping of airways (Airways Mapping Section) was assigned to the Coast and Geodetic Survey, and the research work (Aeronautical

Research Division) was made part of the duties of the Bureau of Standards. The Air Regulations Division and the Air Information Division were at headquarters immediately under the Assistant Secretary. This organization has been continued without appreciable modification.

The first lighted beacon erected by the Aeronautics Branch was put in operation on December 7, 1926, on the Chicago-Dallas route.[31] By June 30, 1927, air navigation facilities had been provided on 1,386 miles of airways on five routes.[32] On these five routes 32 lighted intermediate fields had been established, and 107 airway lights were in operation.[33]

At the end of the first year the air navigation facilities developed on the transcontinental mail route by the Post Office Department were transferred to the Aeronautics Branch. The facilities on the lighted section between New York and Salt Lake consisted of 92 intermediate fields with beacons and boundary lights, 612 beacons, and 17 radio stations. One hundred and forty-six employees were transferred with the facilities.

The first air commerce regulations became effective on December 31, 1926. These regulations include the licensing, inspection, operation, and marking of aircraft, the licensing of pilots and mechanics, and the control of traffic. The first Airway Bulletin was issued in February, 1927.

On July 1, 1927, a Director of Aeronautics was appointed to have immediate supervision of the work, leaving only general supervisory matters with the Assistant Secretary, and on October 4, 1929, the position of Assistant Director was created.

The appropriations for the fiscal year 1928 (45 Stat. L., 85) were $700,000 for general expenses and $3,091,500 for air navigation facilities; of these sums $168,000 for general expenses and $450,000 for air navigation facilities were available during the fiscal year 1927. At the end of May, 1928 (45 Stat. L., 896), there were made available the addi-

[31] *United States Daily*, December 29, 1926, p. 3727.

[32] New York-Boston, St. Louis-Chicago, Dallas-Chicago, Salt Lake City-Pasco, and Los Angeles-Salt Lake City.

[33] Director of Aeronautics, Annual Report, 1927, p. 5.

tional sums of $72,500 for general expenses and $1,000,000 for air navigation facilities, both to continue available through the fiscal year 1929.

At the end of the fiscal year 1928 there were 5,880 miles of lighted airways, with 189 intermediate fields, 1,020 beacons, 48 weather reporting stations, 18 radio stations, and 1 radio range beacon.

On June 30, 1929, the facilities operated were as follows:

Aids to Navigation in Operation, June 30, 1929, Exclusive of Weather and Radio Stations and Telephones

Airway	Miles Lighted	Intermediate Fields Maintained	Beacons Operated
San Francisco-Salt Lake	840	23	158
Salt Lake-Omaha	898	27	111
Omaha-Chicago	430	11	196
Chicago-New York	731	35	124
New York-Boston	201	3	20
Atlanta-New York	788	19	86
Miami-Atlanta			
Jacksonville-Atlanta section	280	7	29
New Orleans-Atlanta			
Selma, Ala.-Atlanta section	226	7	26
Atlanta-Chicago			
Evansville-Chicago section	277	5	15
Louisville-Cleveland	345	9	30
Cleveland-Albany			
Cleveland-Buffalo section	198	5	18
Cleveland-Detroit	134	1	8
South Bend-Kalamazoo	46	1	4
Dallas-Kansas City	541	14	77
Tulsa-Ponca City	76	2	22
Kansas City-Chicago	454	9	34
Cincinnati-Chicago	275	6	25
St. Louis-Chicago	278	8	25
Chicago-Twin Cities	472	9	50
Kansas City-Omaha	159	3	11
Kansas City-St. Louis	228	7	21
Pueblo-Cheyenne	200	6	23
Salt Lake-Pasco	392	10	57
Los Angeles-Salt Lake	664	21	120
Los Angeles-San Francisco	378	8	38
San Francisco-Seattle			
San Francisco-Redding and Portland-Seattle sections	367	4	34
Albuquerque-Wichita			
Albuquerque-Clovis and Waynoka-Wichita sections	305	3	37
Total	10,183	263	1,399

For the fiscal year 1929 there were appropriated $885,850 for general expenses and $4,689,550 for air navigation facilities (45 Stat. L., 85, 896). Of these amounts $72,500 for general expenses and $1,000,000 for air navigation facilities were available also in the fiscal year 1928.

Aids to Navigation Under Construction June 30, 1929, Exclusive of Weather and Radio Stations and Telephones

Airway	Miles to Be Lighted	Intermediate Fields to Be Maintained	Beacons to Be Operated
St. Louis-Evansville	162	4	15
Milwaukee-Green Bay			
Milwaukee-Fond du Lac section	63	1	5
Atlanta-Chicago			
Atlanta-Evansville section	375	8	36
Michigan Airways			
Kalamazoo-Detroit-Bay City section	213	0	13
Cleveland-Albany			
Buffalo-Albany section	261	5	22
New York-Montreal			
New York-Albany section	142	3	13
Salt Lake-Pasco			
Salt Lake-Burley section	178	4	20
San Francisco-Seattle			
Redding-Portland section	400	11	60
St. Louis-Columbus			
Indianapolis-Dayton section	135	0	10
Los Angeles-Albuquerque			
Gallup-Albuquerque section	136	1	15
Total	2,065	37	209

For the fiscal year 1930 the appropriations are $958,000 for general expenses and $5,458,620 for air navigation facilities (45 Stat. L., 1116).

Growth of the Aircraft Industry, 1914 to 1929. The figures below show the development of the aircraft industry as shown by the Census of Manufactures. In this census there are included in a specified industry the figures on number of establishments, wage earners, and value of products if more than 50 per cent of the value of products of a plant pertain to the specified industry. Thus there would be included in the aircraft industry all figures for a plant whose products (in value) to the extent of 51 per cent

pertained to that industry. On the other hand, if 51 per cent of the products in value were automobiles and 49 per cent were aircraft, the figures for the establishment would be included in those for the automobile industry.

Progress of the Aircraft Industry

Year	Number of Establishments	Average Number of Wage Earners	Value of Products	Number of Airplanes Produced
1914.....	16	168	$789,872	(a)
1919.....	31	3,543	14,372,643	432
1921.....	21	1,395	6,652,981	290
1923.....	33	2,901	12,945,263	505
1925.....	44	2,701	12,524,719	711
1927.....	61	4,316	21,161,853	1,888

[a] Not shown.

The figures for 1919 are not strictly comparable with those for later years, as in that year only manufacturers of complete aircraft were classified in the aircraft industry, while in later years plants primarily engaged in manufacturing aircraft parts, other than engines and tires, were included.

The drop in the figures from 1919 to 1921 was due to the fact that in 1919 the aircraft industry was still working on war contracts. The decrease in number of wage earners and value of products from 1923 to 1925 is due to the fact that one large establishment classified in the aircraft industry in 1923 was included in another industry in 1925 for the reasons given in a preceding paragraph.

Figures compiled by the Aeronautics Branch show a production of 4,396 airplanes in 1928, of which 415 were for the Army, 432 for the Navy, 10 for other Government departments, 162 for the export trade, and 3,327 for domestic nongovernmental use.[34] It is estimated that in 1929 the investments in aviation totaled $150,000,000, compared with $5,000,000 in 1926.[35]

[34] Air Commerce Bulletin, Vol. I, No. 5, p. 6, September 2, 1929.
[35] House hearings on Department of Commerce appropriation bill for 1930, p. 61.

Air Transport Routes in Operation, December, 1929
(M, mail; P, passenger; E, express)

Routes	Miles	Service	Schedule	Originally Commenced
DOMESTIC				
New York-Boston	219	ME	6 times weekly	July 1, 1926
do	219	P	2 times daily	Apr. 15, 1929
St. Louis-Chicago (with intermediate stops)	268	ME	Daily	Apr. 15, 1926
St. Louis-Chicago (non-stop)	251	MP	do	Aug. 20, 1928
St. Louis-Omaha	401	MP	2 times daily	May 1, 1929
Dallas-Chicago	995	ME	Nightly	May 2, 1926
Dallas-Kansas City (via Tulsa)	491	PE	Daily	July 1, 1929
Dallas-Kansas City	491	P	do	Apr. 2, 1929
Kansas City-Chicago	454	ME	Daily	Feb. 1, 1928
Tulsa-Ponca City	76	ME	Nightly	July 5, 1928
Los Angeles-Salt Lake	664	MPE	2 times daily [a]	Apr. 17, 1926
Salt Lake-Pasco	530	M	2 times daily	Apr. 6, 1926
Oakland-San Jose	38	MPE	Daily	Dec. 3, 1928
Los Angeles-Seattle	1,080	MPE	do	Sept. 15, 1926
Los Angeles-San Francisco	378	P	3 times daily [b]	Apr. 14, 1928
do	378	PE	do	May 26, 1928
Portland-Seattle	153	PE	2 times daily	Mar. 5, 1928
San Francisco-Portland	549	PE	Daily	do
Agua Caliente-Los Angeles	129	P	3 times daily	Nov. 15, 1927
San Diego-Los Angeles	110	P	do	Mar. 29, 1929
do	110	P	2 times daily	Sept. 1, 1929
Chicago-Twin Cities	407	MPE	do	June 7, 1928
Milwaukee-Green Bay	120	MPE	Daily	Dec. 15, 1928
Pittsburgh-Cleveland	121	MPE	2 times daily	Apr. 21, 1927
Pueblo-Cheyenne	200	MPE	Daily	May 31, 1926
Louisville-Cleveland	345	MP	do	Aug. 1, 1928
Akron-Cleveland	31	M	6 times weekly	Nov. 15, 1928
Chicago-New York	718	ME	2 times daily	July 1, 1919
Chicago-Cleveland	313	P	Daily	Sept. 15, 1928
San Francisco-Chicago (direct)	2,018	MPE	do	Sept. 8, 1920
San Francisco-Chicago (via Lincoln)	2,029	MPE	do	May 1, 1929
Atlanta-New York	769	M	do	May 1, 1928
Washington, D. C.,-New York	201	M	6 times weekly	May 1, 1929
Cleveland-Albany	445	MPE	6 times weekly	Dec. 17, 1927
Cleveland-Buffalo	177	MPE	do	May 1, 1929
Brownsville-Dallas	546	MP	Daily	Feb. 6, 1928
Brownsville-San Antonio	265	P	do	Mar. 9, 1929
San Antonio-Fort Worth	281	P	do	Apr. 1, 1929
Galveston-Dallas	308	M	do	Feb. 6, 1928
do	308	P	do	Mar. 30, 1929
Houston-New Orleans	319	M	do	Jan. 23, 1929
New Orleans-Atlanta	483	MP	do	May 1, 1928
Cincinnati-Chicago	272	MPE	3 times daily	Dec. 17, 1927
Indianapolis-Chicago	165	P	5 times weekly	Oct. 22, 1928
Salt Lake-Great Falls	489	MP	Daily	Aug. 1, 1928
Salt Lake-Pocatello	147	MP	do	May 1, 1929
Chicago-Muskegon-Bay City-Pontiac	521	M	do [c]	July 17, 1928
Cleveland-Bay City	233	M	do	Apr. 1, 1929
Miami-Atlanta	622	M	Daily	Dec. 1, 1928
Tampa-Daytona Beach	129	M	do	Apr. 1, 1929
Atlanta-Chicago	623	MP	do	Dec. 1, 1928
St. Louis-Evansville	145	MP	do	do

[a] Only one trip each way Mondays.
[b] Only one trip each way Sundays.
[c] Except Sunday.

Air Transport Routes in Operation, December, 1929
(M, mail; P, passenger; E, express)—*(Cont'd)*

Routes	Miles	Service	Schedule	Originally Commenced
DOMESTIC—*(Cont'd)*				
Detroit-Cleveland	134	P	2 times daily..	Sept. 1, 1927
Detroit-Chicago	252	P	Daily	Nov. 1, 1928
do	252	E	6 times weekly	Feb. 15, 1926
Detroit-Buffalo	218	E	do	Mar. 28, 1927
Los Angeles-El Paso	800	PE	Daily	Nov. 28, 1927
Los Angeles-Avalon	32	PE	2 times daily..	June —, 1922
Tulsa-Dallas via Wichita Falls	357	PE	Daily	Feb. 11, 1929
Tulsa-Oklahoma City	98	PE	3 times daily..	June —, 1928
Louisville-Indianapolis	108	P	5 days a week.	Oct. 22, 1928
Indianapolis-Detroit	240	P	do	do
El Paso-Dallas	575	P	Daily	Mar. 16, 1929
Tulsa-Wichita	132	P	2 times daily..	
Wichita-Kansas City	173	P	do	
Oklahoma City-Wichita	158	P	Daily	June 3, 1929
Tulsa-St. Louis	358	PE	do	Apr. 2, 1929
Sweetwater-Tulsa	371	P	do	June 15, 1929
Portland-Spokane via Walla Walla	332	PE	3 times weekly	Apr. 15, 1929
Portland-Spokane via Yakima	291	PE	do	do
Kansas City-Twin Cities	415	PE	do	May 6, 1929
Los Angeles-Kansas City	1,439	P	Daily	June 1, 1929
Garden City-Cleveland	1,072	P	do	June 15, 1929
Los Angeles-Columbus	[d] 1,837	P	do	July 8, 1929
Washington-Pittsburgh	132	P	do	Aug. 17, 1929
Pasco-Spokane	127	M	do	Sept. 15, 1929
Pasco-Seattle via Portland	331	M	do	do
El Paso-Pueblo	527	P	do	Sept. —, 1929
Kansas City-Denver	575	P	do	July 29, 1929
New York-Albany	142	P	2 times daily..	May 28, 1929
Dallas-Birmingham	610	P	3 times weekly	June 16, 1929
Seattle-Bremerton	15	P	11 times daily.	June 15, 1929
Milwaukee-Grand Rapids	119	P	3 times daily..	
Kansas City-Denver	685	PE	Daily	Nov. 9, 1929
FOREIGN				
Seattle-Victoria	77	MP	Variable	Oct. 15, 1920
Pilottown-New Orleans	75	M	do	Apr. 9, 1923
Habana-Miami	261	MP	Daily	Oct. 28, 1927
New York-Montreal	334	MP	6 times weekly	Oct. 1, 1928
Miami-Nassau	200	MP	3 times weekly	Jan. 2, 1929
Miami-San Juan	1,445	M	do	Jan. 9, 1929
Cristobal-Miami	2,074	M	do	Jan. 11, 1929
Brownsville-Mexico City	472	M	Daily	Mar. 9, 1929
Santiago, Chile,-Cristobal, Canal Zone	3,071	M	Weekly	May 18, 1929
Cristobal, Canal Zone,-Curacao, Dutch West Indies	890	MP	do	June 21, 1929
Buffalo-Toronto	58	P	6 times weekly	June 29, 1929
Seattle-Vancouver	143	P	Daily	
Twin Cities-Winnipeg	425	P	Daily	July 24, 1929
Paramaribo, Dutch Guiana-San Juan	1,342	M	Weekly	Sept. 20, 1929
Santiago, Chile,-Buenos Aires, Argentina	732	M	Weekly	Oct. 14, 1929

[d] Does not include train mileage from Clovis, N. Mex., to Waynoka, Okla.

The air transport routes in operation in December, 1929, are indicated in the table above. On each route the service is operated in both directions. The indentions indicate portions of the main routes operated in addition to the through service. Two items for the same route indicate separate services by the same operator or by different operators. On practically all the longer routes intermediate stops are made unless the route is marked nonstop.

CHAPTER II

ACTIVITIES

The activities of the Aeronautics Branch may be classified as follows:

1. Licensing of aircraft.
2. Inspection of aircraft.
3. Supervision of marking of aircraft.
4. Licensing of pilots and mechanics.
5. Rating of flying schools.
6. Making air traffic rules.
7. Certification of private aeronautic radio.
8. Enforcement of regulations.
9. Installation and maintenance of airways.
10. Distribution of information regarding flying conditions.
11. Rating of airports.
12. Analysis of accident statistics.

Licensing of Aircraft. All aircraft carrying persons or property for hire or the United States mail must be licensed if operating between the following areas: (1) Between two or more States; (2) between any State and a foreign country; (3) between points in the same State if the flight is over part of another State; (4) between points in the same State if the flight is part of a through carriage between points in different States or between a State and a foreign country; (5) within the District of Columbia or any territory or possession of the United States.

Aircraft used solely for pleasure or for noncommercial purposes need not be licensed, even though they are engaged in flying between States. However, they may be licensed at the request of the owner, and if licensed must comply with all the requirements for licensed aircraft.

In addition to the physical requirements registration is limited to craft owned by a citizen of the United States, by

a partnership of which each member is a citizen, by a corporation of which the president and at least two-thirds of the directors or managing officers are citizens, and of which at least 51 per cent of the voting interest is controlled by citizens, or by the Government of the United States, a State, a territory, or any possession or subdivision.

In addition to the formal conditions as to ownership the plane must meet specified physical requirements. The structure, engine, and propellers must be of a type already approved by the Secretary of Commerce. These elements are not tested separately for each machine licensed, but an inspection is made to see that the machine conforms to the approved type.[1]

The final requirement before issuance of the license is an actual test in the air in order to determine whether the machine meets the performance requirements.

Licensed aircraft are also considered as registered. Unlicensed aircraft are entered of record for purpose of assigning identification marks, but are not considered as registered. On June 30, 1929, the total number of recorded aircraft was 7,287, of which 4,232 were licensed and 3,055 were recorded for purposes of identification only. The distribution of recorded airplanes among the States was as follows:

Distribution of Recorded Aircraft, June 30, 1929

	Licensed	Identified		Licensed	Identified
California	518	378	Texas	173	148
Illinois	299	247	Washington	108	79
Massachusetts	109	64	Wisconsin	121	82
Michigan	235	140			
Missouri	193	131			
New York	752	248		3,116	1,829
Ohio	230	98	Other States	1,116	1,226
Oklahoma	134	97			
Pennsylvania	244	117	Total	4,232	3,055

Licenses are issued for a period of one year, and the craft must be inspected before the license is renewed. Licenses may be canceled at any time for causes specified in the regulations. If the plane is sold, the license must be

[1] The requirements for approved type certificates are given in Aeronautics Bulletin No. 7A.

returned to the Secretary of Commerce and application made for a new one.

Aircraft of those foreign countries which permit craft of the United States to fly without registration and licensing of airmen may operate without license over the territory over which the United States has jurisdiction. Foreign aircraft, however, are not allowed to engage in interstate or intrastate commerce, and must observe the air traffic rules.

Inspection of Aircraft. In addition to the inspection made when the plane is licensed the regulations provide for the inspection of licensed aircraft both by the operator and by a government inspector. The owner or a licensed mechanic must make a line inspection of the airplane at least once in each twenty-four hours preceding flight and the results must be entered in the log. The regulations require that this inspection cover the conditions and state of repair of ten specified features of the equipment and working parts.

After each hundred hours of flight the owner must make a periodic inspection of the engine installation, the control systems, the propellor alignment, and the fuselage. The results of this inspection must also be entered in the log.

Inspection may be made at any time by an authorized representative of the Secretary of Commerce. As a rule, each plane is inspected at least once in the period between the issuance of the original license and its renewal. The time required to inspect a plane is about two and one-half hours.

Factory inspectors are permanently located at all principal aircraft factories for the purpose of minutely inspecting the airplanes produced, both as to workmanship and material. Airplanes which are satisfactorily manufactured and are approved upon inspection, are issued aircraft licenses immediately upon completion.

Supervision of Marking of Aircraft. While only aircraft engaged in interstate or foreign commerce must be licensed, the law requires that all aircraft shall bear identification marks assigned by the Secretary of Commerce. In the case of licensed aircraft the number is assigned when the license

is issued; in the case of unlicensed craft the assignment of the identification number is a purely routine transaction. The identification number ceases to be valid when an unlicensed plane is sold, unless it is reassigned by the Secretary of Commerce, after application by the purchaser.

Licensing of Pilots and Mechanics. The Air Commerce Act provides for the periodic examination and rating of "airmen serving in connection with aircraft of the United States." "Airman" is defined as "any individual (including the person in command and any pilot, mechanic, or member of the crew) who engages in the navigation of aircraft while under way, and any individual who is in charge of the inspection, overhauling, or repairing of aircraft."

Another paragraph defines "aircraft of the United States" as any aircraft registered under the act. Therefore, the licensing of airmen applies to persons serving in connection with all craft which are engaged in interstate and foreign commerce, and which are required to be licensed. In addition it also applies to all aircraft licensed at the option of the owner.

Pilots, who are defined by the regulations as "persons in command of or piloting licensed aircraft in flight," are divided into classes and subclasses as follows:

COMMERCIAL PILOTS:

Transport Pilots—

Aircraft weighing 3,500 pounds or less.
Single engine, open cockpit.
Multi engine, open cockpit.
Single engine, cabin.
Multi engine, cabin.

Aircraft weighing 3,500 to 7,000 pounds.
Single engine, open cockpit.
Multi engine, open cockpit.
Single engine, cabin.
Multi engine, cabin.

Aircraft weighing over 7,000 pounds.
Single engine, open cockpit.
Multi engine, open cockpit.
Single engine, cabin.
Multi engine, cabin.

COMMERCIAL PILOTS—*(Cont'd)*

Limited Commercial Pilots—

Aircraft weighing 3,500 pounds or less.

Single engine, open cockpit.
Multi engine, open cockpit.
Single engine, cabin.
Multi engine, cabin.

Aircraft weighing 3,500 to 7,000 pounds.

Single engine, open cockpit.
Multi engine, open cockpit.
Single engine, cabin.
Multi engine, cabin.

Aircraft weighing over 7,000 pounds.

Single engine, open cockpit.
Multi engine, open cockpit.
Single engine, cabin.
Multi engine, cabin.

Industrial pilots.

Glider pilots.

PRIVATE PILOTS:

Private pilots.

Student pilots.

The privileges and restrictions pertaining to the several classes of pilots are as follows:

Privileges and Restrictions of Commercial Pilots

Item	Transport	Limited Commercial	Industrial	Glider
General privileges and restrictions.	May pilot any type of licensed aircraft, but shall not carry persons for hire in licensed aircraft other than in those types and within the classes specified in their license. They shall not pilot unlicensed aircraft carrying persons or property for hire.	Have all the privileges conferred and are subject to all the restrictions imposed upon transport pilots, except they shall not, for hire, instruct students in the operation of aircraft in flight and they shall not pilot aircraft carrying persons for hire outside of the areas mentioned in their licenses, except they may be permitted to function as copilot on dual-controlled aircraft when accompanied by a transport pilot who is in command of and responsible for the operation of such aircraft, but shall not credit such time as solo-flying experience.	May pilot any type of licensed aircraft not carrying persons for hire, but shall not pilot unlicensed aircraft carrying either persons or property for hire, and shall not, for hire, instruct students in the operation of aircraft in flight.	May pilot any type of motorless aircraft, but shall not transport persons or property, or instruct students except in licensed motorless aircraft.
Minimum age.	18 years.	18 years.	18 years.	14 years.

Citizenship.	(1) A citizen of the United States; or (2) a citizen of a foreign country which grants reciprocal privileges or (3) an alien who has filed a declaration of his intention to become a citizen.	Same as for transport pilots.	Same as for transport pilots.	No restriction.
Experience.	200 hours of solo flying, of which at least 5 hours must have been within 60 days preceding application.	Same solo flying as for industrial pilots.	50 hours of solo flying, of which at least 5 hours must have been within 60 days preceding application.	No minimum flying experience.
Physical qualification.[a]	Good past history; sound pulmonary, cardiovascular gastrointestinal, central nervous, and genito-urinary systems; freedom from material structural defects or limitations; freedom from disease of the ductless glands; normal central, peripheral, and color vision; normal judgment of distance; only slight	Same physical qualifications as prescribed for transport pilots.	Absence of any organic disease or defect which would interfere with the safe handling of an airplane; visual acuity of not less than 20/30 in each eye, although in certain instances less than 20/30 may be accepted if the applicant wears a correction to 20/20 in his goggles and has good judgment of distance without cor-	The same physical qualifications prescribed for private pilots.

[a] In the case of trained, experienced flyers, the Secretary of Commerce may grant waivers for physical defects designated as disqualifying by the regulations when in his opinion the experience of the pilot will compensate for the defect. A waiver once granted will hold indefinitely so long as the defect for which it was granted has not increased or unless canceled by the Secretary of Commerce.

Privileges and Restrictions of Commercial Pilots—(Cont'd)

Item	Transport	Limited Commercial	Industrial	Glider
	defects of ocular muscle balance; freedom from ocular disease; absence of obstructive or diseased conditions of the ear, nose, and throat; no abnormalities of equilibrium that would interfere with flying.		rection; good judgment of distance; no diplopia in any field; normal visual fields and color vision; absence of organic disease of the eye, ear, nose, or throat.	
Tests.	(1) Examination on the air traffic rules and those portions of the Air Commerce Regulations pertaining to pilots' privileges and limitations and to the inspection and operation of aircraft; (2) practical and theoretical examination in elementary engine and plane mechanics and rigging and a theoretical examination in the fundamentals of meteorology and air navigation; (3) practical flight test, as follows: (a) In addition	The same examinations and tests as are prescribed for transport pilots, except the cross-country flight and the examination on elementary meteorology and navigation.	(1) Examination on the air traffic rules and practical and theoretical examination in elementary engine and plane mechanics and rigging and those portions of the Air Commerce Regulations pertaining to pilots' privileges and limitations and to the inspection and operation of aircraft; (2) the practical flight tests prescribed for transport pilots, except the distance for the cross-country flight shall be 60 miles.	In addition to normal take-offs and landings, a series of gentle and moderate banks, together with precision landings will be required.

to normal take-offs and landings, the following maneuvers will be required: from 1,500 feet, with engine throttled, make a 360° turn and land in normal landing attitude by wheels touching ground in front of and within 200 feet of a line designated by examiner for the Department of Commerce; (b) from 1,000 feet, with engine throttled, make a 180° turn and land in normal landing attitude, by wheels touching ground in front of and within 200 feet of a line designated by examiner for the Department of Commerce; (c) a series of five gentle and three steep figure 8 turns from 800 to 1,000 feet, respectively. Spiral in one direction from 2,000 feet, with engine throttled, and land in normal landing attitude by wheels touching ground in front of and within 200 feet of a line des-

Privileges and Restrictions of Commercial Pilots—(Cont'd)

Item	Transport	Limited Commercial	Industrial	Glider
	ignated by examiner for the Department of Commerce; (d) fly in emergency maneuvers, such as spins, spirals, side slips, climbing turns, and recovering from stalls; and such others as the Secretary of Commerce deems necessary; (e) fly over a triangular or rectangular course at least 100 miles landing at place of take-off within five hours. This flight shall also include two obligatory landings, not at point of departure, when craft must come to rest; [b] (f) cross wind landings and take-offs.			

[b] Upon the presentation of satisfactory proof that the candidate has engaged in solo cross-country flights a distance of at least one hundred miles within one year preceding the date of his application, the flight specified will be omitted.

Duration of license.	6 months.	6 months.	1 year.	1 year.
Renewal requirements.	Same physical condition; at least 10 hours of solo flying within preceding 60 days.	Same as for transport pilots.	Same physical condition; at least 25 hours of solo flying within the last year.	Shall have made at least 10 gliding flights or 1 soaring flight of at least 1 hour's duration.

Privileges and Restrictions of Non-Commercial Pilots

Item	Private pilots	Student pilots
General privileges and restrictions.	May pilot licensed aircraft, but shall not carry persons or property for hire in licensed or unlicensed aircraft; shall not, for hire, instruct students in the operation of aircraft in flight.	May pilot licensed aircraft, including gliders, when receiving flying instructions, and such student pilots shall not pilot licensed or unlicensed aircraft carrying persons or property for hire, and shall not pilot licensed aircraft for any other purpose than receiving flying instructions nor within any other area than that specified in their licenses.
Minimum age.	16 years.	16 years.
Citizenship.	No restriction.	
Experience.	10 hours of solo flying of which at least 2 hours must have been within 60 days preceding application.	
Physical qualification.[a]	Absence of organic disease or defect which would interfere with safe handling of an airplane under the conditions of private flying; minimal visual requirement in each eye is 20/40. In certain instances, to be decided in each case by the Aeronautics Branch, the candidate may be qualified if he has a vision less than 20/40 in either or both eyes, provided his depth perception without correction is 30 mm. or better and he wears a correction in his goggles to bring his vision at least to 20/30.	Absence of organic disease or defect which would interfere with safe handling of an airplane under the conditions of private flying; minimal visual requirement in each eye is 20/40. If candidate has 20/50 in one eye and 20/40 or better in the other, he may be accepted, provided his depth perception is 30 mm. or better and his physical examination is otherwise satisfactory, and he wears a correction in his goggles, bringing his vision approximately to normal.
Tests.	(1) Examination on the air traffic rules and those portions of the Air Commerce Regulations pertaining to	

Privileges and Restrictions of Non-Commercial Pilots—(Cont'd)

Item	Private Pilots	Student Pilots
	pilots' privileges and limitations and to the inspection and operation of aircraft; (2) the practical flight test as follows: A series of five gentle and three steep figure 8 turns from 800 to 1,000 feet, respectively. Spiral in one direction from 2,000 feet, with engine throttled, and land in normal landing attitude by wheels touching ground in front of and within 500 feet of a line designated by examiner for the Department of Commerce, and three satisfactory landings.	
Duration of license.	1 year.	1 year.
Renewal requirements.	Same physical condition; at least 10 hours of solo flying within the last year.	

[a] In the case of trained experienced flyers the Secretary of Commerce may grant waivers for physical defects designated as disqualifying by the regulations when in his opinion the experience of the pilot will compensate for the defect. A waiver once granted will hold indefinitely so long as the defect for which it was granted has not increased or unless canceled by the Secretary of Commerce.

The examination is both theoretical and practical. The medical examinations are made by medical officers attached to the Government or by physicians commissioned for this work by the Secretary of Commerce. The theoretical and practical examinations are conducted by the inspectors of the Aeronautic Branch.

A licensed pilot must keep an accurate record of his flying time in a log book. If he is licensed to transport passengers for hire, he must do so in a type of aircraft which he has operated during the preceding ninety days for at least two hours, including ten landings, three of which must have been to a full stop. If he transports passengers at night for hire, he must have had at least two

hours of night solo flying within the last preceding ninety days.

Pilots' licenses may be suspended or revoked by the Secretary of Commerce for offenses specified in the regulations. On October 31, 1929, the number of pilots licensed in the several classes was as follows:

Commercial pilots—	
Transport pilots	4,628
Limited commercial pilots	98
Industrial pilots	1,246
Private pilots	2,929
	8,901

On June 30, 1929, the distribution of pilots of all classes by States was as follows:

Distribution of Licensed Pilots, June 30, 1929

California	1,167	Ohio	267
District of Columbia	183	Oklahoma	111
Florida	117	Pennsylvania	265
Illinois	312	Texas	244
Indiana	117	Virginia	111
Kansas	116	Washington	127
Massachusetts	141	Wisconsin	112
Michigan	297		
Minnesota	108		4,652
Missouri	191	Other States	989
New Jersey	115		
New York	551	Total	5,641

Mechanics are defined in the regulations as "persons repairing or adjusting licensed aircraft in flight and persons in charge of the ground inspection, overhauling or repairing of licensed aircraft." An unlicensed mechanic may repair or overhaul licensed craft if the work is in charge of a licensed mechanic.

Mechanics are licensed as engine mechanics or airplane mechanics.

An engine mechanic must have had at least two years' experience on internal combustion engines, one year of which must have been on aircraft engines. He must pass an examination on the part of the air commerce regulations pertaining to operation and instruction, as well as on the

inspection, maintenance, repair, and overhauling of engines and their accessories, including ignition systems.

An airplane mechanic must have had at least one year's actual experience in servicing aircraft. He must pass an examination on the part of the air commerce regulations pertaining to operation and inspection, and also on the inspection, maintenance, repair and overhauling of plane structures and rigging, including the control systems.

Both classes of mechanics are licensed for two years. Licenses may be suspended or revoked for offenses specified in the regulations. On June 30, 1929, licenses were in force for 5,111 aircraft and engine mechanics. The total of these two classes does not represent that many individuals, as it is probable that many mechanics hold both classes of licenses.

Distribution of Licensed Mechanics, June 30, 1929

California	877	Pennsylvania	280
District of Columbia	106	Texas	235
Florida	130	Virginia	198
Illinois	375	Washington	114
Massachusetts	113		
Michigan	307		
Missouri	139		3,819
New Jersey	178	Other States	1,292
New York	459		
Ohio	308	Total	5,111

Rating of Instructors. The amendment of the Air Commerce Act approved February 28, 1929 (45 Stat. L., 1404), provides for the rating of schools giving instruction in flying, one element of the rating being the competency of the instructors. Such schools are rated only on the application of the owner or representatives, and consequently the rating of instructors is confined to such institutions.

While the term rating is used in the regulations, the action is essentially that of licensing. Instructors are divided into two classes, flying instructors and ground instructors; each of which is rated separately.

Flying instructors must be licensed as transport pilots and in addition must pass a separate flight test prescribed for flying instructors and a practical and theoretical examination on the explanation of flight maneuvers. These

requirements are to give assurance that the instructor not only knows the subject himself, but is also able to impart his knowledge to others. A flying instructor's rating runs concurrently with his transport pilot's license, and may be renewed annually on satisfactory evidence that he has served as a flying instructor in an approved school for not less than one hundred hours in dual instruction.

Ground instructors' licenses are issued in one or more of the following subjects: Engines, airplanes, meteorology, aircraft instruments, safety appliances, aerial navigation, and air commerce regulations. A separate examination is required in each subject. Ground instructors' licenses are in force for one year and may be renewed on satisfactory evidence that the instructor has served as ground instructor in an approved school for a period of not less than half the duration of his rating.

Both flying instructors' ratings and ground instructors' licenses may be revoked for causes specified in the regulations.

The regulations were promulgated on April 17, 1929, and up to October 26, 1929, applications had been received and disposed of as follows:

Applications for rating	77
Approved	22
Disapproved	28
Canceled	3
Under consideration	24

Rating of Flying Schools. The examination and rating of civilian schools giving instruction in flying is authorized by an amendment to the Air Commerce Act approved February 28, 1929 (45 Stat. L., 1404). In accordance with the provisions of the amendment ratings will be made only at the request of the institution. Regulations governing this work were issued on April 17, 1929.

The law specifically provides that the examination and rating shall cover the adequacy of the course of instruction, the suitability and airworthiness of the equipment, and the competency of the instructors. The regulations provide that a school which meets the requirements may be issued an

approved school certificate, which will be in force for one year, unless sooner suspended or revoked, and which may be renewed after inspection and the submission of satisfactory evidence that the required standards are being maintained.

Schools are graded as (1) Flying Schools, (2) Ground Schools, and (3) Ground and Flying Schools. Each of these three major classifications is further subdivided as follows: (a) Private pilot school, (b) Limited commercial pilot school, and (c) Transport pilot school.

The regulations prescribe requirements on the following subjects:

Equipment:
- All planes to be licensed.
- Size and character of field.
- Hangar and shop facilities.
- Number of planes.
- Number of students per plane.
- Classroom and ground course facilities.

Competency of Instructors:
- Flying instructors.
  - All instructors to hold rating from Department of Commerce.
  - Time to be spent in giving flying instruction.
- Ground instructors.
  - All instructors to hold rating from Department of Commerce.

Adequacy of Course of Instruction:
- Time limit of courses.

Records and Reports:
- Individual record to be kept of each student.
- Examination to be given in ground school subjects.
- Outline of all courses to be approved by Department of Commerce.
- Monthly report to be submitted.

Standards:
- Nine out of ten graduates who apply for license must pass tests.
- Personnel and equipment to be sufficient to enable students to complete course in time limit.
- At least two-thirds of students shall graduate, exclusive of those removed for due cause.

Spin instruction to be given prior to solo flight.

Curriculum requirements:

Minimum flying time specified for each class of school. Provision for instruction in air commerce regulations, aviation engines, airplanes, aerial navigation, meteorology, instruments and safety appliances.

Schools are subject to inspection at any time, and approved certificates may be revoked for cause. A school is allowed to advertise its standing as rated, but it is not allowed to advertise courses for a higher grade than the rating specifies. Twenty-four schools had been rated to November 16, 1929.[2]

Making Air Traffic Rules. Authority to make air traffic rules is expressly conferred on the Secretary of Commerce by the Air Commerce Act. As that act makes it unlawful "to navigate any aircraft otherwise than in conformity with the air traffic rules," the rules apply regardless of whether the craft is operated in interstate or intrastate commerce, or in noncommercial flights.

The rules cover right of way in the air, altitude at which flying is permitted, take-off, landing, and lights to be displayed at night.

Certification of Private Aeronautic Radio. In view of the necessity of the communication between aircraft in flight and ground personnel the Aeronautics Branch has arranged with the Federal Radio Commission for the reservation of sixty-four channels in the 1,500-1,600 kilocycle band for the use of communication to and from aircraft.

In order to promote the best use of aeronautic radio the Federal Radio Commission and the Assistant Secretary of Commerce for Aeronautics have reached the following agreement:[3]

(1) All applications received by the Federal Radio Commission covering the establishment of radio stations for

[2] Lists of the approved schools are given in Air Commerce Bulletin, Vol. I, No. 10, November 15, 1929, p. 19, and Vol. I, No. 11, December 2, 1929, p. 14. A review of work of rating is given in Air Commerce Bulletin Vol. I, No. 6, September 15, 1929, pp. 1-4.

[3] *Domestic Air News*, January 15, 1929, p. 10.

aeronautical purposes shall be referred to the Aeronautics Branch of the Department of Commerce, for investigation and certification, in accordance with the Air Commerce Act.

(2) The application, accompanied by the department certification, shall be forwarded to the Federal Radio Commission with recommendation covering frequency assignment.

(3) The private aeronautical radio facility shall be established and operated in accordance with rules promulgated by the Assistant Secretary of Commerce for Aeronautics, so that the station will be co-ordinated to form a part of the National Airways Radio System, and the station shall serve the general use of the public as well as the purpose for which it is established.

The following announcement has been made regarding rating and certification by the Aeronautics Branch.[4]

The Secretary of Commerce will rate all air navigation facilities as to their suitability for use of licensed airmen; and if the facility is found suitable for such use, certificate will be issued for a term of one year, renewable for additional one-year periods upon application and findings of continued suitability by the Secretary of Commerce. If there is a material change of the facility, the certificate will terminate unless such change is approved by the Secretary of Commerce.

The aronautical radio facility shall be made available for use of itinerant flyers, upon demand, without remuneration, during hours of regular operation, thereby serving the same purpose and in the same manner as a station established, owned, and operated by the Government. When the service of an aeronautical radio facility to an operating company or individual becomes habitual or regular, remuneration for the services rendered shall be made in a manner mutually agreed upon. In cases of dispute, the Assistant Secretary of Commerce for Aeronautics will act as arbitrator and his decisions shall be final, unless regular rates are established by the Interstate Commerce Commission.

Should the demand for service from the aeronautical public increase to a point where the privately established radio facility does not meet the demands, the Assistant Secretary of Commerce for Aeronautics may establish a radio station in the same general location capable of adequately serving the aeronautic public and cancel the certification of rating of the private facility or the Assistant Secretary

[4] *Ibid.*, p. 9.

of Commerce for Aeronautics may take over and operate the established radio facility in consideration of the maintenance of the station and the service rendered, under such conditions as may be agreed upon by the Assistant Secretary of Commerce for Aeronautics and the owner, and make any alteration and install additional apparatus as may be necessary to adequately serve the needs of the public within the availability of the appropriations.

Enforcement of Regulations. In the case of pilots and mechanics one method of enforcing the regulations is the suspension or revocation of the license. In addition to this

Enforcement Activities, Year Ending October 31, 1929

Nature of Violation	Total Number	Action Taken					
		Civil Penalties Imposed		Reprimanded	License Suspended	License Revoked	Case Dismissed
		Number of Assessments	Amount Collected				
Acrobatics	78	37	$1,065	14	21	1	5
Low flying	65	14	300	21	13	2	15
Unlicensed pilot flying licensed plane	175	75	1,775	84	8	1	7
Flying without navigation lights	11	6	175	...	4	...	1
Flying without identification numbers	20	8	225	10	2	...	...
Miscellaneous offenses	154	36	1,090	53	33	18	14
Total	503	176	$4,630	182	81	22	42

civil penalties not exceeding $500 may be assessed by the Secretary of Commerce against the pilot or owner or against the aircraft. The law imposes a civil penalty of $500 for a violation, but it also provides that the penalty may be remitted or mitigated by the Secretary of Commerce. This procedure is similar to that followed in the case of the navigation laws.

If the violation is by the owner or person in command,

the penalty is a lien against the aircraft which may be summarily seized.

During the year ending October 31, 1929, there were 493 violations of the regulations, the offenses and the penalties imposed being given on page 40.

Installation and Maintenance of Airways. An airway may be defined as a course in the air which terminates at each end in a public landing field or airport, which is marked by lights on the ground (at approximately 10-mile intervals), which has emergency landing fields (at approximately 30-mile intervals) properly marked by day and night, which has radio stations (at approximately 200-mile intervals), and which has stations where weather information may be obtained.

For the purposes of the Air Commerce Act a civil airway is defined as "a route in the navigable air space designated by the Secretary of Commerce as a route suitable for interstate or foreign air commerce."

The establishment and maintenance of airways by the Secretary of Commerce is specifically authorized by the Air Commerce Act, but no exclusive right to the use of an airway may be granted.

The course of the airway is determined by surveys before any facilities are installed. Between the airports or regular landing places along the airway, the course is laid out in as nearly a straight line as the topography of the region will permit. A survey is first made from the air, and later a ground survey is made in order to verify the aerial survey and to obtain additional information regarding obstructions.

The lighting of the airway is to furnish a distinctive light to guide the aviator flying at night. It was first developed by the Post Office Department in connection with the transportation of mail by airplane. It has been further developed and improved by the Aeronautics Branch, which has taken over the aids to air navigation installed by the Post Office Department. Mr. F. C. Hingsburg, the Chief Engineer of the Airways Division of the Aeronautics

Branch, has described the system of Aeronautical Lights as follows:[5]

The basic principles of aeronautical lighting are the same as those applying to marine lighting, except that different conditions prevail. The airplane travels with great speed, through three dimensional spaces, over terrain dotted with millions of stray lights. The pilot engaged in flying his airplane has many instruments to watch, and the lights on his course ahead of the airplane are obscured in a large measure by a whirling propeller, windshield and his goggles, whereas an officer on the bridge of a steamer devotes substantially all his time to picking up relatively few lights which are identified with the aid of binoculars.

On clear nights the airplane may fly high and the patterns formed by the lights of cities and stray lights serve as aeronautical beacons of first magnitude. But good weather is not regularly encountered, and low clouds force the pilot to fly low. Under these conditions the stray lights lose their characteristics and become confusing.

In the same manner as a steamer sails definite courses from buoy to buoy so as not to run aground, airways marked by beacons and provided with landing fields are laid out following the best terrain to secure the highest possible percentage of flying efficiency and enable safe landings at intermediate fields to be made in case flying becomes impossible.

It is evident that aeronautical lights must have adequate candlepower which should be in excess of competitive, stray lights. Street lights will vary in candlepower from 1,000 to 5,000 and advertising signs may have candlepower extending from several thousand to several million. In the vicinity of a city are encountered a myriad of lights illuminating the atmosphere. If aeronautical lights are to be identified by their candlepower, extremely brilliant lights are required. Under such conditions lights of distinctive color and characteristic are advantageous.

A distinctive characteristic is required by which an aeronautical light may be identified among the many stray lights. A rotating light is distinctive as compared with fixed lights, but has no individuality. At airports the rotating beacon may be used as an aeronautical light giving the pilot a long-range indication of its aeronautical character, but an auxiliary light is required to flash its individuality by Morse letters or numbers, in order that the particular airport may be identified.

[5] *Ibid.*, No. 32, July 15, 1928, p. 17-20.

On civil airways the rotating searchlight beacon is used in conjunction with course lights. Ten lights of this character are established to each block of 100 miles and numbers are flashed on the course light projectors giving the mileage location along the airway. Red course lights are used at beacons where no landing fields are located. Yellow course lights are to be used at intermediate landing fields. It would be a great help to the pilot to have green auxiliary beacon lights in addition to the long-range airport beacon to identify the airport by Morse letters from the air. The use of red, yellow and green auxiliary beacon lights to indicate landing conditions is rational.

The light should be projected into the air at angles that will render maximum aid to the pilot. For cross-country flying an aeronautical light should preferably be visible all around the horizon and to the zenith. The advantages of lighted air routes are again apparent. By the use of course lights a projector with 15° beam spread is pointed along the course in each direction and the available light is concentrated into a 15° beam spread instead of being dissipated around 360°, thereby increasing the candlepower twenty-four fold. The proper distribution of light in the vertical plane is of importance. No advantage of optical apparatus is possible if the light is to show the same candlepower around the horizon and to the zenith. The distribution of light intensities will depend on the spacing of lights along the route. The greatest candlepower from any given beacon should be projected at an angle that will meet the pilot when he is flying above the adjacent beacons. Since the average height of airway flying is from 500 to 1,500 feet above the ground, the elevations of the light in degrees may be calculated. A chart showing angles of beacon light elevations has been prepared by Airways Division. As airplanes often drift off the course, an off-course indication is required and the 24-inch rotating beacon is used for this purpose in conjunction with the course lights.

The latest Department of Commerce's rotating beacon is a very efficient piece of optical apparatus. The light from a thousand watt T20 airway lamp is concentrated by a parabolic reflector into a beam of 2,000,000 candlepower having a 4° beam spread. The axis of the beam is elevated to project on to an airplane 1,000 feet above the adjacent beacons. This is accomplished even though the beacon be located on a hill top, valley, or side hill by shimming the base plate of the apparatus to the proper level so that the elevated beam of light makes the proper angle with the slope of the ground.

The front cover glass of the rotating beacon has prisms on the inside surface which deflect some of the light upward from 0° to 25° so that the pilot will not miss the beam by flying too far above it as he approaches over the airway. The latest improvement of the Department is a half drum lens mounted as a saddle on the searchlight drum, gathering the light otherwise lost on the inside of the drum into a fan-shaped beam of light, showing at 90° to the axis of the main beam. As the beacon rotates showing from the horizon through the zenith to the horizon opposite, secondary flashes of 12,000 candlepower are emitted 2½ seconds before and after the principal flash. The zenith light is a considerable aid to the pilot about to land at a landing field or at close range to the beacon, especially in thick weather.

The luminous period of an aeronautical light is a very important factor, and it should be sufficient to fix the position of the light in the mind of the observer. For marine lights the minimum luminous period found satisfactory is 10 per cent. When the eclipse periods exceed 90 per cent of the cycle time, complaints result. A satisfactory aeronautical light for airports should have a minimum candlepower of 100,000 and 10 per cent luminous period according to airport rating regulations. The candlepower may be decreased if the luminous period is increased proportionally, and the same effectiveness is reached up to 50 per cent luminous periods. The opposite conditions exists where rotating beacons are used, the candlepower is higher, but the luminous period is less. The course lights used on airway beacons have a luminous period of 35 per cent, which is considered about right.

Light flashes should be of sufficient duration to develop the maximum luminous value upon the retina of the observer's eye. The effectiveness of a light is not dependent upon candlepower alone, but the duration of the flash is a very important factor. It has been proved in marine practice that the full luminous value of a light is reached when the duration of flash is in excess of ¼ second. With flashing electric lights the time of heating and cooling of lamp filaments must be considered. In code signals the duration of dashes should be three times the duration of dots, and eclipses between dots and dashes should be not less than the duration of the dot. The eclipse between cycles should be in excess of the duration of the dash period.

Close spacing of lights along an airway is essential for the highest percentage of flying efficiency, but each light should have the required minimum candlepower to meet the

competition of stray lights. The Post Office Department initiated a system of three-mile spacing of acetylene lights between intermediate fields, but the candlepower of the aeronautic light was only 180, and therefore did not fulfill the requirements. These have subsequently been replaced or augmented by powerful rotating electric beacons spaced between intermediate landing fields.

The Airways Division is bringing out an acetylene airway route beacon that promises to be the solution of close-spaced lights, especially in isolated and sparsely inhabited sections. It combines the highest development of railroad signal practice with the marine range light system, and is applied to airway lighting in a new and unique manner. Two lanterns are used, one being mounted above the other. The top lantern is an azimuth and zenith light, having a separate flasher, piping and gas supply and flashing 40 flashes per minute of 180 candlepower. The lower light is a course light of 15° beam spread and 5,000 candlepower, flashing 20 flashes per minute. The lower light is a double-ended range lantern such as is used for marking channels and the optical system is an 18-inch bull's eye lens with 10-inch doublet lens such as is used in modern railroad signal practice. The acetylene light offers the greatest degree of reliability with its dual lanterns, each with separate mechanism and gas supply, and its automatic features enable its installation in isolated localities for operation without attendance for periods of six months or more. These lights will be spaced about three miles apart. They bring within the realm of possibility, close spacing of lights of adequate candlepower, luminous period and distinctive characteristics at a cost of installation and maintenance comparable to electric lights at ten-mile spacing.

The ceiling height at a landing field for airplanes or any point along an airway is the height of the clouds above the ground. This information is very important to the pilot, as it advises him how low he will be obliged to fly to keep below the clouds, and whether a landing is feasible at the terminal field. Very few pilots fly above a solid formation of clouds, as contact with the ground is lost and the pilot must necessarily come down blind through the clouds to make a landing. If he has information or is advised by radio as to the ceiling height at the terminal field, he has some assurance of making a safe landing, but otherwise the ceiling may extend to the ground and landing safely in fog is not yet an assured accomplishment. Knowing the elevation of the cloud level at several points along an airway, the pilot may, by referring to a profile of the airway, determine what sections of the airway are enveloped in the ceiling,

and by flying blind through these areas it may be possible to complete trips that otherwise would not be attempted. Accuracy in measuring ceiling heights is very necessary. In the daytime hydrogen balloons ascending at a definite known rate, may be used. The balloon is watched until it ascends out of sight, and noting the time of ascension and knowing the rate, the height may be calculated. At night and on dark days, ceiling lights may be used, the height of the clouds above the ground being determined by triangulation.

The ceiling light projector consists of a 5 per cent silico aluminum drum mounted on a pedestal and trunnion so that the light may be elevated at a predetermined angle. The drum supports a 14-inch diameter precision parabolic mirror of 4¾-inch focal length, and at the focus a 250-watt G30 flood light lamp is mounted in a medium screw socket and support capable of adjustment for proper focussing. Peep sight holes are drilled in the side of the drum, which when aligned with a cross mark on the opposite side causes the line of sight to pass through the focus and permit accurate adjustment of the lamp. A concentric, stray light shield confines the beam of light to a narrow diameter and causes a brilliant spot to be projected onto the clouds. To assure accurate settings the base of the projector is mounted on a level platform and three holes in a quadrant on the side of the drum are provided to bolt the drum in one of four positions, horizontal, 23° 34′ above horizontal (arc tangent ½), 45° above horizontal (arc tangent 1), or 63° 26′ above horizon (arc tangent 2).

If the ceiling light is elevated 45° the shaft of light forms the hypothenuse of a right triangle, and the height of the clouds on which the light spot is visible is equal to the distance from the light, to a point measured on the ground directly below the light spot. This is the method commonly used for determining ceiling heights. This system requires measuring distances or pacing these distances at night, under all conditions of weather, and causes delay in quickly gathering weather information. The light may be projected 63° 26′ above the horizon and a right triangle is formed in which the ceiling height is twice the distance from the light to a point directly under the spot, measured horizontally along the ground. There are a number of advantages in the latter arrangement. The light spot is smaller, more nearly concentric, and lighter. It is a known fact that the area of a projected beam increases as the square of the distance from the light and the brightness decreases in like proportion.

The elevation of all ceiling lights installed by the Airways Division is 63° 26′ and an instrument for direct reading of ceiling heights in feet, without any measuring, is set up permanently at a distance of 500 feet from the ceiling-light projector—(Airways Division Sketch No. 516). The alidade consists of a bronze quadrant with readings of ceiling heights engraved in white enameled numerals on a black background. The quadrant is fastened to the cap of a 4″ pipe standard and a universal joint is provided for proper leveling. Inverted triangular lights on a movable limb are used for sighting the light spot on the clouds, and the pointer shows the height of the ceiling in feet on the quadrant. To adjust the alidade set the pointer at 0 feet on the quadrant and sight on the ceiling light projector, making the required adjustment by means of the screws in the universal joint.

As a rule the lights are ten miles apart, and in clear weather the aviator is always in sight of one light.

All lights are installed by the Aeronautics Branch. Lighting is obtained by three methods: (1) By purchase of electric current from a public utility if current is available, (2) by the generation of electric current from a farm-type lighting plant installed and owned by the Government, (3) by the use of acetylene burners. All lights are switched on and off automatically. Gasoline driven electric generating sets are installed in duplicate with a thermostatic relay control to stop the operating generator if it becomes too hot, and start the stand-by generator.

At least twice a month all lighting facilities are inspected by service mechanicians. Each crew is assigned to an airway section 175 miles in length. It is provided with a motor truck of the speed-wagon type, equipped with spare parts and tools for making repair jobs.

On June 30, 1929, there were in operation 10,183 miles of lighted airways on which there were 1,399 airway beacons.

Radio beacons are being installed in order to assist the pilot in keeping on his course. In January, 1930, radio beacons were in operation at Hadley Field, New Jersey; Bellefonte, Pennsylvania, and Cleveland, Ohio. Additional beacons were being installed at Goshen, Indiana; Sterling, Illinois; York, Nebraska; Des Moines, Iowa; Gothenburg, Nebraska, and Key West, Florida. The new stations will

give complete directive radio beacon service between New York City and North Platte, Nebraska.

Intermediate landing fields are established at intervals of approximately ten miles along the airway. These may be somewhat off the direct line of the airway, as, in addition to selecting an area suitable for landing, an endeavor is made to locate the intermediate field close to passable roads and to lines of telephone communication.

The number of intermediate fields on each airway on June 30, 1929, was as follows:

Intermediate Fields, June 30, 1929

Airway	Number of Fields	Area in Acres		Rental	
		Total	Average	Total	Average per Acre
San Francisco-Salt Lake City	23	2,771.7	120.5	$5,803.17	$2.09
Salt Lake City-Omaha	27	2,871	106.4	6,433.42	2.24
Omaha-Chicago	11	523	47.5	5,670.00	10.84
Chicago-New York	35	1,790.2	51.1	18,983.50	10.60
New York-Boston	3	115	38.3	1,081.00	9.40
Atlanta-New York	19	1,054.9	55.5	8,633.00	8.18
Miami-Atlanta Jacksonville-Atlanta section	7	616	86.4	914.00	1.48
New Orleans-Atlanta Selma, Ala.,-Atlanta section	7	296	42.2	2,185.00	7.38
Atlanta-Chicago Evansville-Chicago section	5	305	60.1	2,110.00	6.91
Louisville-Cleveland	9	416.1	46.2	2,778.00	6.67
Cleveland-Albany Cleveland-Buffalo section	5	257.2	51.4	605.00	2.35
Cleveland-Detroit	1	106.6	106.6	533.20	5.00
South Bend-Kalamazoo	1	45	45	540.00	12.00
Dallas-Kansas City	14	659	47	4,195.50	6.37
Tulsa-Ponca City	2	135	67.5	370.00	2.74
Kansas City-Chicago	9	449.5	49.9	4,411.00	9.81
Cincinnati-Chicago	6	322	53.6	4,500.00	10.87
St. Louis-Chicago	8	320	40	3,200.00	10.00
Chicago-Twin Cities	9	383.5	42.6	4,834.00	12.60
Kansas City-Omaha	3	123.3	41.1	1,233.00	10.00
Kansas City-St. Louis	7	485	69.2	1,705.00	3.51
Pueblo-Cheyenne	6	620	103.3	1,637.00	2.64
Salt Lake City-Pasco	10	709	70.9	4,791.00	6.75
Los Angeles-Salt Lake City	21	2,533	120.6	1,565.08	.62
Los Angeles-San Francisco	8	701.3	87.6	5,234.00	7.46
San Francisco-Seattle San Francisco-Redding and Portland-Seattle sections	4	304	76	1,724.00	5.67
Albuquerque-Wichita Albuquerque-Clovis and Waynoka-Wichita sections	3	765	255	82.00	.10
Total	263	19,677.3	74.8	95,750.87	4.87

These fields have day marks and night beacons to assist the aviator in making a landing, but no facilities for repairs or refueling. They are not intended to be used as regular landing places, their sole purpose being to afford a place where a safe landing may be made in an emergency.

The usual size of an intermediate field is seventy acres, but there are larger fields in the higher altitudes and smaller ones in low country. They are not owned by the Government, but are leased. The characteristics of an intermediate field as as follows:[6]

. . . The standard intermediate field in low altitudes provides two landing strips or runways of a length of 2,000 feet and width of 600 feet, approximately at right angles to each other, with one strip lying in the direction of the prevailing wind. Such a field has an area of 47 acres. In the higher altitudes (above 4,000 feet) the standard length for landing strips is 2,500 to 3,000 feet. Landing strips may form a "T," "L," or "X," and the inner angles at the junctions of the strips are usually beveled off to provide additional diagonal landing space for use under conditions of strong cross winds. In many cases it is possible to secure triangular or square fields giving the desired runway lengths in all directions. In rough country it is often possible to secure only one landing strip, in which case an attempt is made to increase the width of such a "two-way field" sufficiently to permit landing diagonally into strong cross winds.

The field surfaces should be fairly level, and when not level must be free from sharp breaks in grade, and well drained, naturally or by artificial methods. Fields throughout the Middle West have required little surface preparation, but in the mountainous sections of the East and West and the Piedmont region of the South considerable clearing of brush and timber, grading and smoothing of surface, and tile drainage have been required.

* * * *

Intermediate fields are marked by 50-foot (diameter) white circles at the intersections of the runway center lines, with white panels 20 feet long and 2 feet wide extending from the outside of the circle along the runway center lines to indicate the landing directions. The circle and panels are constructed of crushed rock tamped flush with the field

[6] Director of Aeronautics, Annual Report, 1928, pp. 14-15.

surface and whitewashed. The boundaries of the fields are marked by chrome yellow sheet metal cones 30 inches in diameter and 24 inches in height, installed immediately below the boundary lights and attached to the boundary light standards.

The lighting of intermediate fields comprises a beacon, boundary lights, range lights, obstruction lights, and illuminated wind indicator. A standard 24-inch revolving beacon is provided at each field, with the exception that in mountainous territory, where fields lie off the air line marked by beacons or in valleys at irregular intervals between beacon sites, electric blinkers of lower candlepower are provided; and in desert or uninhabited regions, where commercial electricity is not available, nor supplies of gasoline and oil and attendants to operate local electric generators cannot be had, acetylene beacons, which may be charged up for a six-month period of operation without attention, are installed in lieu of standard electric equipment.

Standard boundary lights, installed at intervals of approximately 300 feet around the perimeters of the fields, consist of waterproof prismatic globes and fittings mounted on iron pipe standards 30 inches above the ground (where snowfall of greater depth is anticipated the height of standards is increased), in which are installed 15-watt electric bulbs if commercial current is available, or 10-watt bulbs if power is provided by a local generator. An underground parkway cable carries the current to the boundary lights.

Range lights, installed in the boundary system and similar in all respects to boundary lights, except that the wattage of the bulbs is increased by 10, and that the clear globes are replaced by green globes, are placed at opposite ends of the principal runways to aid pilots in making landings. Two such range lights are used at each end of the best or prevailing wind runway, and single lights mark the center line of the other runway.

Obstructions at the ends of landing strips or runways over which approaches or take-offs must be made are marked in all cases by red lights at the heights of such obstructions. Obstruction lights have 25-watt electric bulbs in lighthouse red globes. Where only a few isolated obstruction lights are necessary, connection is made with the boundary light circuit. Where obstructions are in the nature of pole lines, or lines of trees, separate overhead electrical circuits are sometimes provided. Obstructions along the sides of runways, where the width of runways do not permit of landing or taking off across them, are marked by red

obstruction lights at obstruction height if isolated, or by obstruction lights at obstruction heights at the extremities of a line of obstructions, supplemented by red lights in the boundary-light system between the extremities.

Desert fields are boundary-lighted by special acetylene blinkers flashing 100 times per minute, established at the corners of the fields and the centers of long sides. Range lights, obstruction lights, and illuminated wind indicators cannot be provided, but in such cases all obstructions have been removed.

Illuminated wind indicators are supported on brackets attached to the beacon towers. A conventional wind cone or sock 8 feet long, 18 inches in diameter at the mouth, and 8 inches in diameter at the opposite end, of porous weave, is colored chrome yellow. A 75-watt electric lamp is installed at the mouth with a chromium-plated reflector which directs the entire output of light into the sock. This indicator shows wind direction at a wind velocity of 5 miles per hour. At greater velocities the sock inflates and rises proportionately, reaching an agle of 7° below the horizontal at a wind speed of 30 miles per hour.

Weather reports on local conditions are made by employees of the Airways Division and the Weather Bureau, but all interpretations are made by the staff of the Weather Bureau, which is specifically directed by the Air Commerce Act to make forecasts to promote the safety of air commerce on civil airways designated by the Secretary of Commerce. On June 30, 1929, the Weather Bureau also maintained forty-five upper air meterological stations at which information regarding upper air conditions was obtained. It also provides twenty-four hour service at five airports and more limited service at thirteen others. It also has 110 special airway weather reporting stations from which frequent daily reports of local conditions are obtained. In addition the observations made at the local Weather Bureau stations are also available to the personnel furnishing special airway weather information.

Communications regarding meteorological conditions are relayed to all airports along the airway, and in addition radiotelephone service is being developed.

In January, 1929, the radiotelephone service was confined to the eastern end of the transcontinental airway, the stations in operation being located at Hadley Field, Bellefonte,

and Cleveland. By September 15, 1929, radiotelephone stations were in operation as follows: Maywood (Chicago), Illinois, Omaha and North Platte, Nebraska, Kansas City and St. Louis, Missouri, Wichita, Kansas, Cheyenne and Rock Springs, Wyoming, Salt Lake City, Utah, Elko and Reno, Nevada, and Oakland and Los Angeles (Glendale), California.

These stations will also accept all traffic to and from radio-equipped aircraft required for the safety of flight, but since few planes are completely radio-equipped, this service has not been established.

It is planned to collect weather information and ascertain landing conditions at important landing fields along the airway, and broadcast this information on definite schedules. The Weather Bureau will analyze and interpret the weather data and prepare short range forecasts, which will be broadcast from the radio stations at the same periods.

Radiotelegraph stations were in operation in the following points, in addition to radiotelegraph utilized at stations in the list of radiotelephone stations:

Washington, District of Columbia.
Richmond, Virginia.
Greensboro, North Carolina.
Spartanburg, South Carolina.
Atlanta, Georgia.
Moline, Illinois.
Oklahoma City, Oklahoma.
Forth Worth, Texas.
Strevell, Idaho.

Teletype circuits between weather reporting stations on the Chicago-New York and Los Angeles-San Francisco airways have been established and are in operation for transmission of hourly reports from the airways weather reporting station.

The estimated installation cost per thousand miles of airway is as follows:[7]

Beacons:

30 farm lighting plant type at $2,850 each....	$85,500
30 automatic at $1,600 each.....	48,000
20 acetylene type at $600 each.....	12,000

[7] House hearings on Department of Commerce appropriation bill for 1930, p. 59.

Radio stations; 5 at $24,000 each	120,000
Intermediate fields:	
Clearing and preparing 30 fields, at $150 each	4,500
Construction cost, 30 intermediate fields at $5,500 each	165,000
	$435,000

The estimated maintenance cost per thousand miles of airway is as follows:[8]

Personal service:	
Caretakers:	
30 at intermediate fields at $600 and $300 per annum	$150,000
30 at beacons obtaining current from farm lighting type of generator at $480 per annum	14,400
30 at automatic beacons at $60 per annum	1,800
Weather observers; 20 at $600 per annum	12,000
Airway mechanicians; one for each 150 miles, at $2,400 per annum	16,000
Radio operators; 20 at $2,400 per annum	48,000
Travel:	
Operation of trucks for airway mechanicians	14,000
Replacements	5,000
Subsistence of airway mechanicians in the field	10,000
Supplies (gasoline, oil, lamps, electric current, etc.):	
30 intermediate fields, at $1,100	33,000
30 beacons operated from lighting plants at $700	21,000
30 automatic beacons at $700	21,000
20 acetylene beacons, at $150	3,000
Rentals:	
30 intermediate fields at $400	12,000
60 beacon sites at $20	1,200
General repairs and maintenance:	
Repairs to structures and equipment at 110 sites	3,800
Mowing intermediate fields and clearing snow; 30 fields at $30	900

[8] House hearings on Department of Commerce appropriation bill for 1930, p. 59.

Communication:	
Telephone tolls at 20 intermediate fields for gathering weather information at $360	7,200
Telephone service for weather forecasts, 40 calls per day, at 50 cents per 200 miles	3,700
Maintenance of five radio stations:	
Electric power at $1,000 per station	5,000
Tubes and supplies at $1,200 per station	6,000
Rent and fuel at $200 per station	1,000
Total	$255,000

Airports are not operated by the Aeronautics Branch, as the Air Commerce Act excludes such facilities from the work in connection with the establishment of airways. They are operated by municipalities, by chambers of commerce, and as private enterprises. The Army and the Navy also operate airports for their own use, and the Air Commerce Act provides that the heads of Departments having control of such fields may in emergency make them available to private aircraft, and may also furnish such supplies and mechanical services as will enable the craft to proceed to the nearest airport operated under private enterprise. The receipts which represent the cost of services and supplies are credited to the appropriation concerned.

Distribution of Information. The Air Commerce Act makes it the duty of the Secretary of Commerce to "collect and disseminate information" regarding the development of air commerce and the aeronautical industry and trade.

The primary data needed by air navigators are facts regarding the physical conditions on the airway, including lights and landing fields. To accomplish this the Aeronautics Branch is publishing a series of airway strip maps on a scale of one to five hundred thousand, with a five hundred-foot contour interval. These as a rule are about ten by thirty-two inches and represent an area about eighty miles wide and two hundred and fifty miles long. The airway is generally shown in approximately the center of the map, which, therefore, shows the topographic features for forty miles on each side. The map also shows rivers, outstanding ridges or mountains, towns, principal roads,

railroads, airports, and landing fields. Altitude and relief are shown by the use of contours and by the printing of tints, each tint having a range of one thousand feet in elevation above sea level, in areas below three thousand feet, and of two thousand feet in the higher altitudes.

There is some duplication of mapping, due to the overlapping of routes between the various cities. To overcome this difficulty and to furnish maps for those who do not follow the regular routes, it is planned to publish sectional maps which will be called "United States Airway Charts." For this purpose, the United States is divided into sections covering three degrees of latitude and four degrees of longitude, which permits the publication of an averaged-sized sheet twenty-six by twenty-eight inches, using the same scale as the strip maps, eight miles to the inch.

The first of these maps to be published will cover territory east of the Mississippi River, where the multiplication of routes creates a greater need for this form of map.

The Army Air Corps and the Hydrographic Office of the Navy Department also publish airway maps, those of the Hydrographic Office showing only the routes along the coast and through the West Indies. The Army Air Corps maps were all started before the passage of the Air Commerce Act, and it appears likely that no further issues will be made in this series.

While some of the maps in the three series overlap slightly, as a rule the three sets are mutually exclusive, and the lists of the three series must be consulted in order to determine what maps are available. Index maps and lists of the three series are published in Aeronautics Bulletin No. 10. Arrangements have been made to distribute these maps through the agencies of the American Automobile Association, the Aeronautical Chamber of Commerce, and at all airports that have facilities for handling their sale.

On June 30, 1929, the status of mapping of airways was as follows:

Mapped by United States Army	6,078
Mapping by Coast and Geodetic Survey:	
Completed	2,099

In progress	2,121
To be undertaken	4,393
Total	14,691

Information regarding airports is given in the Airway Bulletins, each of which is devoted to a particular airport. The bulletins are two-page leaflets, and are printed on sheets 4⅜ by 7¼ inches, punched to fit a ring binder. On the face is a sketch map of the city and vicinity, showing the position of the airport, and a larger scale map of the landing field, showing the shape of the field, the dimensions and position of the runways, facilities provided, obstructions, and structures. On the reverse is text containing information on the following subjects:

Class of field.
Geographic position.
Description of field.
Description of obstructions.
Markings and identification signs.
Lighting.
Accommodations.
Communication and signal equipment.
Summary of weather conditions for the particular locality.

Aiding the Establishment of Airports. Information is supplied to municipalities, chambers of commerce, and other civic organizations on both the technical aspects of airport development and the problems connected with operation. This work includes also the stimulation of interest through talks on the advantages of airport development. During the fiscal year 1929 visits were made to 636 cities, and 251 addresses were made. In addition considerable information was supplied through correspondence and by means of publications.

Airports in operation were as follows:

	Commercial	Municipal
June 30, 1927	217	203
June 30, 1928	325	352
December 31, 1928	365	368
June 30, 1929	414	420

Rating of Airports. One of the regulatory powers specifically conferred on the Secretary of Commerce by the Air Commerce Act is to "provide for the examination and rating of air navigation facilities available for the use of aircraft of the United States as to their suitability for such use" (44 Stat. L., 569). Another section of the act defines "air navigation facility" as including "any airport, emergency landing field, light or other signal structure, radio directional finding facility, radio or other electrical communication facility, and any other structure or facility, used as an aid to air navigation." An airport is defined in the act as meaning "any locality, either of water or land, which is adapted for the landing and taking off of aircraft and which provides facilities for shelter, supply, and repair of aircraft; or a place used regularly for receiving or discharging passengers or cargo by air."

As the Air Commerce Act specifically excepts airports from the air navigation facilities which may be established and maintained by the Secretary of Commerce, it follows that the operation of airports must be by private enterprise, by the States, or by their minor civil divisions. The use by the public of airports operated by the Army and the Navy is incidental to their use for military purposes and is allowed only under special regulations.

The rating of airports is a distinct innovation in the field of the relation of the Government to commerce. For many years the Government has published charts showing the depth of water in harbors, and occasionally it has issued publications enumerating or describing the port facilities and the railroad connections. It has never attempted a definite rating of ports devoted to water-borne commerce. It has not even attempted to describe railroad terminals, which are necessarily corporately owned.

While the act gives the Secretary of Commerce power to rate all airports, the regulations provide for rating only on application of the owners. A rating certificate for an indefinite period is issued after an investigation by a representative of the Secretary of Commerce. Major changes must not be made without the approval of the Secretary. The rating certificate may be revoked or a lower rating

assigned, but periodic inspections are not made in order to insure the maintenance of the standard. A higher rating may be assigned at any time when the conditions warrant such action.

The airport ratings are indicated by a letter (A to D) indicating general equipment and facilities, a number 1 to 5 and 0) indicating size of effective landing area, and a letter (A to E and X) indicating night lighting equipment. Separate ratings are given on airports for landplanes and airports for seaplanes. As regards general equipment and facilities and night lighting, the ratings for seaplane airports have the same indicators as those for landplane airports, but the indicators for seaplane airports on size of effective landing area are 1 to 4 and 0. While landplane and seaplane airports have the same indicators, except as noted, the requirements are different. The rating of the airports is expressed as "A1A," etc., A1A being the highest rating.

The Secretary may waive the requirement when the facts justify such action, in which case the letter or figure is underscored. Thus an airport bearing the rating "A1A" is one which has not fully met the requirements of "1" rating on size of effective landing area, but which has been granted this rating because of special conditions impossible to change that are fully compensated by other conditions.

The ratings for airports cover the following features:[9]

[9] The requirements are given in full in Aeronautics Bulletin No. 16: Airport Rating Regulations, 1929.

Requirements for Airports

Class of Airport	Basic Requirements
Landplane airports.	Suitability of landing area. Freedom from obstructions. Accessibility. On good road. Markings. Landing area to be marked; name of city to be indicated; outline of usable portion to be marked. Runways. Of specified construction and not less than 100 feet in width. Drainage. To be adequate. Fuel, communication, transportation and personnel. The airport shall be provided with facilities for supplying aircraft with fuel, oil, and water, also drinking water shall be available. If there are no rest rooms on the airport, a suitable latrine shall be provided. The airport shall have dependable communication and transportation facilities to the nearest city or town. Airport personnel shall be in attendance by day or available on call by telephone at the airport. In the latter case, a directory and full instructions for reaching such personnel shall be available in the telephone booth or receptacle.
Seaplane airports.	The seaplane airport shall be situated on or directly connected with a body of water having a minimum depth of not less than 6 feet at any time, calm enough for operations in all ordinary weather, and sufficiently large to permit landing and taking-off of seaplanes and flying boats without hazard. By direct connection is meant a canal or other stream of water wide enough to allow taxiing of planes without difficulty and a distance of not over one-quarter of a mile from the actual airport to the open water. The airport shall be situated on a good road leading to the nearest city or town. It shall be equipped with an approved type of wind-direction indicator, and shall be marked either on hangar roof or other suitable area, or on land immediately adjacent to the water, with the name of the city or town in the manner required for marking airports for landplanes. The airport shall be provided with facilities for supplying aircraft with fuel, oil, and water; also drinking water shall be available. If there are no rest rooms on the airport, a suitable latrine shall be provided. The airport shall have dependable communication and transportation facilities to the nearest city or town. Airport personnel shall be in attendance by day or available on call by telephone at the airport. In the latter case, a directory and full instructions for reaching such personnel shall be available in the telephone booth or receptacle.

Facilities	Rating on General Equipment and Facilities			
	A Rating	B Rating	C Rating	D Rating
LANDPLANE AIRPORTS. Hangar.	80x100 feet with 18-foot overhead clearance and with provision for heating oil and water.	Same as A Rating except that size may be 60x80 feet, with 14-foot overhead clearance.	Same as A Rating except that size may be 50x60 feet, with 12-foot overhead clearance.	Fields which do not possess sufficient general equipment to obtain A, B, or C ratings, but which meet the basic requirements, will receive a rating of "D" on general equipment.
Wind - direction indicator.	One or more wind-direction indicators of an approved type, equivalent in effect to a wind cone not less than 12 feet long, 36 inches in diameter at the throat, 12 inches in diameter at the tail, constructed of open-weave unbleached yellow muslin, and so mounted as to fly freely with the wind. This wind-direction indicator shall be so located as to give a true indication of the wind on the landing area and as to be readily visible to aircraft approaching the airport from any direction. In	Same as A Rating.	One or more wind-direction indicators as required for an "A" rating, except that wind cone shall be not less than 9 feet long, 24 inches in diameter at the throat, and 10 inches in diameter at the tail.	do

	case it is not visible to aircraft approaching from any direction, such additional wind-direction indicators shall be installed as may be necessary.			
Day-marking of obstructions.	All telephone and transmission line poles, radio towers and masts, transmission towers, flagpoles, and similar obstructions in the immediate vicinity of the airport shall be daymarked by painting with alternate bands of either chrome yellow and dead black, or white and dead black, terminating with either a chrome yellow or a white band at the top, depending on the color combination used. The width of the bands shall be one-fifth of the height of the structure for all structures less than 250 feet high, and for structures over 250 feet high the bands shall be 50 feet wide. Such structures as	do	No requirement.	do

Facilities	Rating on General Equipment and Facilities—*(Cont'd)*			
	A Rating	B Rating	C Rating	D Rating
LANDPLANE AIRPORTS. *(Cont'd)*	chimneys and water towers in the immediate vicinity of the airport are not required to be painted in this manner unless, in the opinion of the Secretary of Commerce, such painting is necessary from the standpoint of safety. The posts of landing area fencing shall be painted either chrome yellow or white.			
Weather instruments.	An anemometer, barometer, thermometer, a bulletin board, and facilities for giving pilots the most recent weather information.	Same as A Rating.	No requirement.	As stated on page 60.
Snow removal.	Adequate equipment for removing snow from landing areas or landing strips or equipment for packing snow sufficiently to permit safe landing and taking off of aircraft.	do	do	do

First aid equipment.	First-aid equipment consisting of an ambulance, or some vehicle which can be used as an ambulance, equipped with the following: First-aid kit, drinking water, crowbar, wire cutters, hack saw, ax, cloth-cutting shears, fire extinguisher, two litters. The first-aid kit shall contain at least 12 assorted bandages, 12 sterile dressings, 2 tourniquets, a supply of first-aid dressings for burns, adhesive tape, a supply of either tincture of iodine or mercurochrome, aromatic spirits of ammonia, and a paper or glass cup. The litters should preferably be of the Stokes Navy type. If they are of the ordinary type, then the vehicle shall also carry an assortment of splints.	do	Same as A Rating.	do
Register.	A register of arriving and departing aircraft to include the following information: License	do	do	do

Facilities	Rating on General Equipment and Facilities—*(Cont'd)*			
	A Rating	B Rating	C Rating	D Rating
LANDPLANE AIRPORTS. *(Cont'd)*	number and model of arriving or departing plane; owner of plane; pilot of plane and his license number; time of arrival and departure; number of crew; number of passengers; space for remarks covering any unusual situation.			
Fire-fighting equipment.	As this depends on the size and number of buildings, spacing of structures, type of construction, etc., no definite rule can be made which will apply to each case, but such rating will depend upon recommendation of the department representatives, who will be guided in a large measure by the standards of the National Board of Fire Underwriters.	Same as A Rating.	Same as A Rating.	As stated on page 60.
Radio apparatus.	Airports located within a radius of 400 miles of	No requirement.	No requirement.	do

	Department of Commerce airways radio stations shall be equipped with suitable radio-receiving sets with loud speakers, in order that those using the airport may avail themselves of the hourly weather reports broadcast from said stations. As additional airways radio stations are installed by the Department of Commerce, airports located within a radius of 400 miles of such stations and previously granted an "A" rating on general equipment and facilities shall provide themselves with suitable radio-receiving sets and loud-speakers in order to retain this rating.		
Repair equipment.	Sufficient to permit changing of engines and landing gear and equipment for *major* engine and plane repairs.	Sufficient to permit changing of engines and landing gear and equipment for *minor* engine and plane repairs.	do
Day servicing personnel.	Sufficient personnel in attendance throughout	Sufficient personnel in attendance throughout	do

Facilities	Rating on General Equipment and Facilities—*(Cont'd)*			
	A Rating	B Rating	C Rating	D Rating
LANDPLANE AIRPORTS. *(Cont'd)*	the day to give proper operation of the airport, including servicing aircraft making *major* repairs, giving weather service, and operating the fire-fighting equipment.	the day to give proper operation of the airport, including servicing aircraft, making *minor* repairs, giving weather service, and operating the fire-fighting equipment.		
Sleeping quarters.	Sleeping quarters for at least *three* men, in addition to the field personnel, at the airport or not more than one-half mile distant.	Sleeping quarters for at least *two* men, in addition to the field personnel, at the airport or not more than one-half mile distant.	No requirement.	As stated on page 60.
Waiting and rest room.	Waiting and rest room on the field.	Rest room.	Rest room.	do
Restaurant.	If not actually on the airport, this shall be not more than one-half mile distant.	No requirement.	No requirement.	do
SEAPLANE AIRPORTS. Hangar.	80x120 feet, with 22-foot overhead clearance and with provision for heating water and oil.	Same as A Rating except the size may be 80x100 feet, with 18-foot overhead clearance.	Same as A Rating except that size may be 50x60 feet, with 16-foot overhead clearance.	Seaplane airports which do not possess sufficient general equipment to obtain A, B, or C ratings, but which meet the basic requirements,

				will receive a rating of "D" on general equipment and facilities.
Wind - direction indicator.	Same as A Rating for landplane airports.	Same as A Rating for landplane airports.	Same as C Rating for landplane airports.	do
Day-marking.	do	do	No requirement.	do
Repair equipment.	Sufficient to permit changing engines, pontoons, and amphibian landing gear in addition to equipment for *major* engine, plane, and hull repairs.	Sufficient to permit changing engines and pontoons and amphibian landing gear, in addition to equipment for *minor* engine, plane, and hull repairs.	No requirement.	do
Hauling out.	This will require either a marine railway or a suitable ramp. Dollies, cradles, or other apparatus suitable for carrying seaplanes and flying boats from the water into the hangar will be necessary, as well as power for hauling out cradles when loaded, such as a small tractor, a motor truck, or a winch.	Same as A Rating.	Same as A Rating.	do

Facilities	Rating on General Equipment and Facilities—*(Cont'd)*			
	A Rating	B Rating	C Rating	D Rating
SEAPLANE AIRPORTS. *(Cont'd)* Boat.	Capable of at least 10 knots speed for towing disabled planes to the airport and for use as a tender and rescue boat.	Same as A Rating, but speed may be 8 miles per hour.	Same as B Rating.	As stated on pages 66 and 67.
Radio apparatus.	Same as A Rating for landplane airports.	No requirement.	No requirement.	do
Weather instruments.	do	Same as A Rating for landplane airports.	do	do
First-aid equipment.	do	do	Same as A Rating for landplane airports.	do
Register.	do	do	do	do
Fire-fighting equipment.	do	do	do	do
Personnel.	do	Same as B Rating for landplane airports.	No requirement.	do
Sleeping quarters.	do	do	do	do
Restaurant.	do	No requirement.	do	do

Mooring facilities.	Mooring facilities properly placed offshore for flying boats or seaplanes.	Same as A Rating.	do	do
Waiting and rest room.	Both at or near hangar.	Rest room at or near hangar.	Rest room.	do

	Rating on Effective Landing Area					
	1 Rating	2 Rating	3 Rating	4 Rating	5 Rating	0 Rating
Landplane airports.	In addition to the basic requirements an effective landing area of at least *2,500* feet in all directions, with clear approaches; the field to be in good condition for landing at all times; or it shall have landing strips not less than *500* feet wide, permitting landing in at least eight directions at all times, the landing strips not to	Same as 1 Rating except that landing area and landing strips may be *2,000* feet or the airport shall have two landing strips, one aligned with the general direction of the prevailing wind, permitting at least four-way landing at all times and having clear approaches, the landing strips to be at least 500 feet wide and	Same as 1 Rating except that the landing area and the landing strip may be *1,600* feet or the airport may have two landing strips as in 1 Rating, but *2,500* feet in length. When the airport lies at an altitude in excess of 1,000 feet above sea level, the dimensions of the effective landing area or the effective lengths of the landing	Same as 1 Rating except that the landing area and the landing strip may be *1,320* feet or the airport may have two landing strips as in 2 Rating but *1,800* feet in length. When the airport lies at an altitude in excess of 1,000 feet above sea level, the dimensions of the effective land-	Airports not having landing areas meeting the minimum requirements for a "4" rating on size but which request rating, and which the Secretary of Commerce considers safe for the use to which they are being put, shall receive the rating of "5" on size of landing area.	An airport which, in the opinion of the Secretary of Commerce, is unsafe for operation, but from which operations are nevertheless taking place and which requests a rating, will be rated "0" on size of effective landing area.

	Rating on Effective Landing Area *(Cont'd)*					
	1 Rating	2 Rating	3 Rating	4 Rating	5 Rating	0 Rating
	cross or converge at angles of less than 40° nor any one of the landing strips to be less than *2,500* feet in effective length, with clear approaches. When the airport lies at an altitude in excess of 1,000 feet above sea level, the dimensions of the effective landing area or the effective lengths of the landing strips shall be increased as provided.	not less than *3,000* feet in effective length and not to cross or converge at an angle of less than 60°. When the airport lies at an altitude in excess of 1,000 feet above sea level, the dimensions of the effective landing area or the effective lengths of the landing strips shall be increased as provided.	strips shall be increased as provided.	ing area or the effective lengths of the landing strips shall be increased as provided.		
Seaplane airports.	Unobstructed climb after taking off. The existence of reefs, shoals, sand bars, etc., within the distance	Unobstructed climb after taking off. The existence of reefs, shoals, sand bars, etc., within the distance pre-	Unobstructed climb after taking off. The existence of reefs, shoals, sand bars, etc., within the distance pre-	Unobstructed climb after taking off. The existence of reefs, shoals, sand bars, etc., within the dis-	No rating.	A seaplane airport which, in the opinion of the Secretary of Commerce, is unsafe for operation, but

prescribed below will eliminate consideration for rating unless, in the opinion of the Secretary of Commerce, marking and lighting of these dangerous obstructions eliminate all hazard. Such markers will, of course, conform to local and Federal harbor or river regulations both for day markers and night lights.	scribed below will eliminate consideration for rating unless, in the opinion of the Secretary of Commerce, marking and lighting of these dangerous obstructions eliminate all hazard. Such markers will, of course, conform to local and Federal harbor or river regulations both for day markers and night lights.	scribed below will eliminate consideration for rating unless, in the opinion of the Secretary of Commerce, marking and lighting of these dangerous obstructions eliminate all hazard. Such markers will, of course, conform to local and Federal harbor or river regulations both for day markers and night lights.	tance prescribed below will eliminate consideration for rating unless, in the opinion of the Secretary of Commerce, marking and lighting of these dangerous obstructions eliminate all hazard. Such markers will, of course, conform to local and Federal harbor or river regulations both for day markers and night lights.
Clear approaches and long enough for *4,000*-foot effective run in all directions.	Clear approaches and long enough for *3,500* feet effective run in all directions, or it shall have two landing courses at least 600 feet wide and not less than *4,000* feet in effective length, and not to cross or converge at an angle of less than 60°.	Same as 2 Rating except that effective run in all directions may be *3,000* feet or the alternative landing courses shall not be less than *3,500* feet in length.	A seaplane airport which meets the basic requirements but which is not large enough to receive a "3" rating on size of landing area will be rated as "4" if, in the opinion of the Secretary of Commerce, marking and lighting of these dangerous obstructions eliminate all hazard. Such markers will, of course, conform to local and Federal harbor or river regulations both for day markers and night lights.
			A seaplane airport which meets the basic requirements but which is not large enough to receive a "3" rating on size of landing area will be rated as "4" if, in the opinion of the Secretary of Commerce, marking and lighting of these dangerous obstructions eliminate all hazard. Such markers will, of course, conform to local and Federal harbor or river regulations both for day markers and night lights.
			Same as 2 Rating except that effective run in all directions may be *3,000* feet or the alternative landing courses shall not be less than *3,500* feet in length.
			Clear approaches and long enough for *3,500* feet effective run in all directions, or it shall have two landing courses at least 600 feet wide and not less than *4,000* feet in effective length, and not to cross or converge at an angle of less than 60°.
			prescribed below will eliminate consideration for rating unless, in the opinion of the Secretary of Commerce, marking and lighting of these dangerous obstructions eliminate all hazard. Such markers will, of course, conform to local and Federal harbor or river regulations both for day markers and night lights.

from which operations are nevertheless taking place and which requests a rating will be rated "O" on size of effective landing area.

	Rating on Effective Landing Area *(Cont'd)*					
	1 Rating	2 Rating	3 Rating	4 Rating	5 Rating	0 Rating
				opinion of the Secretary of Commerce, it provides sufficient area for the use to which it is being put.		

	Rating on Night Lighting Equipment					
	A Rating	B Rating	C Rating	D Rating	E Rating	X Rating
LANDPLANE AIRPORTS.						
Airport beacon.	The requirements for a satisfactory aeronautical beacon light for airports are adequate candlepower, not less than 100,000 for long range; proper distribution of light in the vertical plane	Same as A Rating.	Same as A Rating.	Airports which do not possess night-lighting equipment to receive a "C" rating but which possess an airport beacon and boundary-light system, together	Airports which have necessary night-lighting equipment to meet the requirements of any of the A, B, C, or D ratings and which keep this equipment available for	The rating of "X" will be given to airports which have no night-lighting equipment, or which do not provide all-night operation of lighting equipment or which do not

	to make the beacon visible all around the horizon and to the zenith, or nearly so, for altitudes of from 500 to 2,000 feet; distinctiveness for identification; flashes of not less than one-tenth second duration; luminous period of not less than 10 per cent; and eclipse periods of not more than 10 seconds duration.			with an illuminated wind-direction indicator and adequate obstruction lights, will be given a rating of "D", providing all such lighting equipment is kept burning all night every night.	operation on request, but which do not give the all-night operation required for these ratings, will be given the rating of "E" on night-lighting equipment.	keep this equipment available for operation on request as required.
Illuminated wind indicator.	There shall be at least one illuminated wind-direction indicator, internally or externally lighted, equivalent in effect to the wind cone described under the requirements for an "A" rating on general	do	An illuminated wind-direction indicator as required for an "A" rating, except that the wind-direction indicator shall be equivalent in effect to at least the wind-direction indicator required for a "C"	do	do	do

	Rating on Night Lighting Equipment—*(Cont'd)*					
	A Rating	B Rating	C Rating	D Rating	E Rating	X Rating
LANDPLANE AIRPORTS. *(Cont'd)*	equipment and facilities. A lamp of not less than 200 watts with suitable reflector will be required for the internal lighting of this wind cone. For external lighting, a suitable system of reflectors with at least four 100-watt lamps, or the equivalent, shall be so mounted above the wind cone as to make it readily visible in every direction.		rating on general equipment and facilities.			
Boundary lights.	The outline of the usable portion of the landing area shall be shown at night by boundary lights	Same as A Rating.	Same as A Rating.	As stated on pages 72 and 73.	As stated on pages 72 and 73.	As stated on pages 72 and 73.

	spaced not more than 300 feet apart and served by an underground distribution system.					
Obstruction lights.	All obstructions on and in the vicinity of the airport shall be clearly marked with red lights of the same wattage or lumen output as the red lights specified for the boundary circuit.	do	do	do	do	do
Hangar flood lights and roof marking.	The exterior surface of each hangar on the airport shall be flood lighted to an average intensity of illumination of at least 2½ foot candles. The exterior surfaces of the hangars, excepting roof areas	Exterior surface of one hangar to be flood lighted. Name of city shown as required in A Rating.	The name of the city or town marked on a hangar roof or other suitable area, and illuminated, as required for an "A" rating.	do	do	do

	Rating on Night Lighting Equipment—*(Cont'd)*					
	A Rating	B Rating	C Rating	D Rating	E Rating	X Rating
LANDPLANE AIRPORTS. *(Cont'd)*	used as the background for air markings, shall be of such a color as to reflect not less than 50 per cent of the light, and at least one hangar roof, or other suitable area, shall be marked with the name of the city or town. Said marking shall be so illuminated as to be visible from an altitude of at least 2,000 feet.					
Ceiling projector.	For use as a ceiling projector there is required an incandescent searchlight with a parabolic reflector of not less than 12 inches	Same as A Rating.	Same as A Rating.	As stated on pages 72 and 73.	As stated on pages 72 and 73.	As stated on pages 72 and 73.

in diameter and with at least a 250-watt lamp of the concentrated filament type used for a spotlight or headlight service and a stray light shield giving a beam spread of not to exceed 7 degrees (preferably not more than 5 degrees), or an equivalent apparatus. (Projectors limited to these minimum requirements will not necessarily be large enough to handle the needs of every airport. In some cases, depending upon local conditions, it may be necessary to use units up to 24 inches in diameter and with 1,000-watt lamps.) The

Rating on Night Lighting Equipment—*(Cont'd)*

A Rating	B Rating	C Rating	D Rating	E Rating	X Rating
ceiling projector shall be mounted on a yoke with a quadrant or other suitable means for elevating and holding the light at the proper angle. In case the projector is used in such a manner as to necessitate the measuring of vertical angles, an inclinometer, transit, or theodolite shall be provided, or in lieu thereof an alidade so graduated and installed as to give direct readings of the ceiling height.					

Landing area, flood light system.	This system, which may consist of one or more units, shall be such as to provide an even distribution of illumination (free from abrupt changes in intensity and from shadow areas) over the entire usable portion of the landing area. There shall be sufficient intensity of illumination to reveal the details of the surface and make depth perception readily possible from a minimum altitude of 30 feet in the center of the lighted area. The minimum vertical plane intensity of illumination over the usable portion of the land-	A landing area flood-light system, portable or otherwise, which will provide suitable illumination for safe landing of airplanes under ordinary conditions and which will give a minimum vertical plane intensity of illumination over the usable portion of the landing area, or a portion thereof equivalent to the area required for landing area, or a portion thereof equivalent to the area required for a "1" rating on size, of at least 0.035 foot candle.	No requirement.	As stated on pages 72 and 73.	As stated on pages 72 and 73.	As stated on pages 72 and 73.

	Rating on Night Lighting Equipment—*(Cont'd)*					
	A Rating	B Rating	C Rating	D Rating	E Rating	X Rating
LANDPLANE AIRPORTS. *(Cont'd)*	ing area shall not be less than 0.15 foot candle. The flood-light system shall be immediately available for use through the operation of control located at convenient point and shall be sufficiently elaborate or flexible to permit landing under all conditions of wind direction without the necessity of landing directly toward the light source. There shall be sufficient light to illuminate objects and obstacles in the immediate vicinity of the air-					

	port in the direction of the beam, and the flood-light unit or units shall be so designed and installed as to eliminate glare and blinding of the pilot.					
All night operation.	The airport beacon wind-direction indicator lights, boundary lights, obstruction lights, and roof marking lights shall be kept burning all night (from sunset until sunrise) every night. (It is preferable that this equipment be kept burning from one-half hour before sunset until one-half hour after sunrise.)	Same as A Rating.	Same as A Rating.	As stated on pages 72 and 73.	As stated on pages 72 and 73.	As stated on pages 72 and 73.
Night personnel.	Sufficient personnel shall be in attendance throughout the	Sufficient personnel in attendance throughout the night for proper	Attendance available on request.	do	do	do

	Rating on Night Lighting Equipment—*(Cont'd)*					
	A Rating	B Rating	C Rating	D Rating	E Rating	X Rating
	night for proper operation of the lighting equipment, for servicing aircraft, *making minor repairs*, and giving weather service, and for operating the fire-fighting equipment.	operation of the lighting equipment, servicing aircraft, giving weather service, and operating fire-fighting equipment.				
SEAPLANE AIRPORTS.						
Airport beacons.	Same as A Rating for landplane airports.	Same as A Rating for landplane airports.	Same as A Rating for landplane airports.	Seaplane airports which do not possess sufficient night-lighting equipment to receive a "C" rating but which possess either an airport beacon or boundary light system, or both, together with an illumi-	Airports which have the necessary night-lighting equipment to meet the requirements of any of the A, B, C, and D ratings and which keep this equipment available for operation on request,	The rating of "X" will be given all seaplane airports which have no night-lighting equipment, or which do not provide all-night operation of lighting equipment or which do not keep this equip-

				nated wind-direction indicator and suitable obstruction lights, will be given a rating of "D", providing all such lighting equipment is kept burning all night every night.	but which do not give the all-night operation required for these ratings, will be given the rating of "E" on night-lighting equipment.	ment available for operation on request as required.
Illuminated wind-direction indicator.	do	do	Same as C Rating for landplane airports.	do	do	do
Boundary lights.	Suitable.	Suitable.	Suitable.	do	do	do
Obstruction lights.	do	do	do	do	do	do
Ceiling projector.	Same as A Rating for landplane airports.	Same as A Rating for landplane airports.	Same as A Rating for landplane airports.	do	do	do
Landing area flood light system.	do	Same as B Rating for landplane airports.	No requirement.	do	do	do
Hangar flood lights and roof marking.	do	Same as A Rating for landplane airports.	Same as A Rating for landplane airports.	do	do	do

Rating on Night Lighting Equipment—*(Cont'd)*

	A Rating	B Rating	C Rating	D Rating	E Rating	X Rating
SEAPLANE AIRPORTS. *(Cont'd)* All night operation.	Same as A Rating for landplane airports.	Same as A Rating for landplane airports.	Same as A Rating for landplane airports.	As stated on pages 82 and 83.	As stated on pages 82 and 83.	As stated on pages 82 and 83.
Night personnel.	do	Same as B Rating for landplane airports.	Available on request.	do	do	do

The amended airport rating regulations became effective January 1, 1929. Up to June 30, 1929, no airports had actually been rated, but many applications for ratings have been received and investigated.

Analysis of Accident Statistics. The Air Commerce Act makes it the duty of the Secretary of Commerce to "investigate, record, and make public the causes of accidents in civil air navigation in the United States." Civil air navigation is not defined in the act, and while the Secretary may investigate, through any sources and means available to him, accidents to unlicensed craft, it is doubtful whether he can request accident reports from civil aircraft which are lawfully unlicensed. The Secretary, however, has power to revoke licenses of aircraft and pilots, and it necessarily follows that he has authority to require reports from licensed craft and pilots. The Air Commerce Regulations (Section 34) require specifically that if accidents result in serious injury to persons or property, a prompt report must be made on the form provided.

The reports on accidents are analyzed by a board consisting of two pilots, a statistician, a flight surgeon, an aeronautical engineer, and a lawyer in order that all factors entering into an aircraft accident may be covered by persons having specialized knowledge. The ultimate purpose of such analysis is to discover the causes of aircraft accidents with a view to recommending means for their elimination. Information on accidents is available in statistical form only, and the particulars of any one accident are not made public.[10]

[10] In connection with the accident to the airplane City of San Francisco near Mount Taylor, New Mexico, on September 3, 1929, resulting in the death of eight persons, the Secretary of Commerce offered to transmit the findings in confidence to a member of the Senate (Cong. Rec., Daily Ed., September 30, 1929, p. 4260). On October 23 the Senate adopted a formal resolution requesting the Secretary to furnish the Senate with statement of the cause of this accident as well as of another one (*Ibid.*, October 23, p. 5004). In compliance with this resolution the Secretary, on October 26, transmitted a report which gave the desired information, but which concluded with the statement that "the Department of Commerce does not attempt to determine any

Research in Aeronautical Problems. The desirability of research work in connection with the development of aviation is specifically recognized by the Air Commerce Act. The Secretary is given broad discretion as to whether the research work shall be carried on by the Bureau of Standards or by other agencies of the government. Up to the present the research work has been carried on almost entirely in the Bureau of Standards, a unit of that Bureau functioning as a division of the Aeronautics Branch.

As in all research work the specific subjects studied will vary from time to time in accordance with the problems that are pressing for solution. During the first year the work was confined largely to the development of radio beacons and of lights for indicating the course of the airway.

During the second year the work on lights and radio beacons has been continued, and in addition studies have been made of methods of soundproofing airplane cabins, of airplane control, and of the strength of welded joints in the tubing used for the construction of the fuselage.

Co-ordination With National Advisory Committee for Aeronautics. Research work in aeronautic problems is also undertaken by the National Advisory Committee for Aeronautics, which is authorized "to supervise and direct the scientific study of the problems of flight, with a view to their practical solution, . . . and to discuss their solution and their application to practical questions" (38 Stat. L., 930).

The National Advisory Committee outlines its duties as follows:[11]

First. Under the law the committee holds itself at the service of any department or agency of the Government interested in aeronautics, for the furnishing of information or assistance in regard to scientific or technical matters

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legal responsibilities which may be involved. Rather, the investigations are for the purpose of arriving at practical conclusions, in an effort to apply remedial measures in future operations" (*Ibid.*, October 31, 1929, p. 5217). The ruling of the Secretary of Commerce was sustained in an opinion of the Attorney General dated February 19, 1930 (for text of opinion see Air Commerce Bulletin, March 15, 1930, pp. 1-3).

[11] Nat. Adv. Com. Aeronautics, Annual Report, 1928, p. 2.

relating to aeronautics, and in particular for the investigation and study of fundamental problems submitted by the War and Navy Departments with a view to their practical solution.

Second. The committee may also exercise its functions for any individual, firm, association, or corporation within the United States, provided that such individual, firm, association, or corporation defray the actual cost involved.

Third. The committee institutes research, investigation, and study of problems which, in the judgment of its members or of the members of its various subcommittees, are needful and timely for the advance of the science and art of aeronautics in its various branches.

Fourth. The committee keeps itself advised of the progress made in research and experimental work in aeronautics in all parts of the world, particularly in England, France, Italy, Germany, and Canada.

Fifth. The information thus gathered is brought to the attention of the various subcommittees for consideration in connection with the preparation of programs for research and experimental work in this country. The information is also made available promptly to the military and naval air organizations and other branches of the Government, and such as is not confidential is immediately released to university laboratories and aircraft manufacturers interested in the study of specific problems, and also to the public.

Sixth. The committee holds itself at the service of the President, the Congress, and the executive departments of the Government for the consideration of special problems which may be referred to it.

By act of Congress approved July 2, 1926 (44 Stat. L., 788), and amended March 3, 1927 (44 Stat. L., 1380), the committee was given an additional function. This legislation created and specified the functions of an Aeronautical Patents and Design Board, consisting of an Assistant Secretary of War, an Assistant Secretary of the Navy, and an Assistant Secretary of Commerce, and provided that upon favorable recommendation of the National Advisory Committee for Aeronautics the Patents and Design Board shall determine questions as to the use and value to the Government of aeronautical inventions submitted to any branch of the Government. The legislation provided that designs submitted to the Board should be referred to the National Advisory Committee for Aeronautics for its recommendation, and this has served to impose upon the committee the additional duty of considering on behalf of the Government all aeronautical inventions and designs submitted.

While there is authority, the National Advisory Committee has not done any work specifically directed to the problems of the Aeronautics Branch, but has conducted many investigations for the Army and the Navy. Owing to differences in methods of flight, the stresses in a combat machine are not the same as in commercial aircraft.

The field of operations of the National Advisory Committee is broader than that of the Research Division of the Aeronautics Branch, in that it includes theory, study of problems that look to future development instead of immediate application, and special investigations for the Army and the Navy. The work of the Research Division of the Aeronautics Branch is confined to the direct application of principles to the particular problems created by the work of fostering and developing commercial aviation. The work of the National Advisory Committee finds its main expression in publications available to the entire industry, while the products of the Research Division of the Aeronautics Branch are generally specialized devices for immediate use. Overlapping is prevented through co-ordinating committees representing all the services interested.

The appropriations for the National Advisory Committee since its creation have been as follows:

Fiscal Year:

1915.....	$5,000.00	1923.....	225,000.00
1916.....	5,000.00	1924.....	307,000.00
1917.....	87,515.70	1925.....	440,000.00
1918.....	112,000.00	1926.....	564,000.00
1919.....	206,357.33	1927.....	513,000.00
1920.....	181,305.66	1928.....	550,000.00
1921.....	208,706.04	1929.....	836,770.00
1922.....	212,700.00	1930.....	1,292,200.00

In addition to the research on specific problems the National Advisory Committee passes on all patents and designs submitted to the Aeronautical Patents and Design Board for purchase by the United States. It also endeavors to co-ordinate aircraft activities through annual conferences with representatives of the aircraft industry, and with representatives of educational institutions engaged in aeronautical education. It also collects and classifies all data

published in the United States and abroad dealing with any phase of aeronautics. To further this phase of the work the "committee maintains a technical assistant in Europe, with headquarters at the American Embassy in Paris. It is his duty to visit the government and private laboratories, centers of aeronautical information, and private individuals in England, France, Italy, Germany, and other European countries, and endeavor to secure for America not only printed matter which would in the ordinary course of events become available in this country, but more especially to secure advance information as to work in progress and any technical data not prepared in printed form and which would otherwise not reach this country."

CHAPTER III

ORGANIZATION

Unlike most other organic acts establishing government activities, the Air Commerce Act did not create an organization unit to carry on the work. All the powers and duties enumerated in the act are conferred on the Secretary of Commerce. It provided an additional Assistant Secretary to aid the Secretary of Commerce, and the air navigation work became technically a part of the Office of the Secretary. As the divisions in the office of the head of a department are ordinarily engaged in administrative work relating to all the bureaus of the department, the unit handling the air commerce work, which was similar to that undertaken by the bureaus, could hardly be called a division. Nor could it be called a bureau, as that term was not used for subdivisions of the Office of the Secretary. Therefore, the designation Aeronautics Branch was applied to the organization.

As far as functions and duties are concerned, the Aeronautics Branch ranks as a bureau. Its immediate head is an Assistant Secretary of Commerce for Aeronautics, a position especially created by law for the particular purpose.

The organization differs somewhat from that generally followed in that three of its main subunits are attached to other bureaus in the Department. The Airways Division is in the Bureau of Lighthouses, the Aeronautics Research Division in the Bureau of Standards, and the Airways Mapping Division in the Coast and Geodetic Survey. These units look to the Aeronautics Branch for general instructions regarding work to be undertaken, but the technical details and routine administrative supervision are under the respective bureaus.

Office of Assistant Secretary of Commerce. The Air Commerce Act provides that there shall be an additional

Assistant Secretary of Commerce appointed by the President, by and with the advice and consent of the Senate, to "aid the Secretary of Commerce in fostering air commerce and to perform such functions vested in the Secretary under this act as the Secretary may designate."

The Assistant Secretary is also a member of the Patents and Design Board, which was created by the act of July 2, 1926 (44 Stat. L., 788), and which is authorized to evaluate patents and designs for aircraft offered to the United States for its use. The other members of the Board are the Assistant Secretaries of War and of the Navy in charge of aviation activities in the War and the Navy Departments.

From the organization of the service in July, 1926, up to July 1, 1927, the Assistant Secretary was in immediate charge of the Aeronautics Branch; on that date a Director of Aeronautics was appointed to be in charge of the details, and for some time the Assistant Secretary was engaged in general supervision. Late in 1929 a Director of Air Regulation and a Director of Aeronautics Development were appointed, and the Assistant Secretary again became the immediate head of the Branch. Thus, at the end of 1929, there were four units reporting directly to the Assistant Secretary, as follows:

Administrative Division.
Office of Director of Air Regulation.
Office of Director of Aeronautic Development.
Airways Division.

Administrative Division. The Administrative Division handles the general administrative details that are common to all units of the Aeronautics Branch. Its work includes all matters connected with the budget, accounting, filing, personnel, supplies and equipment, and assignment of space. It does not do any disbursing, which is one of the duties of the Disbursing Clerk of the Office of the Secretary of Commerce. In November, 1929, its staff included 24 persons. It is divided into the following subsections, whose names indicate their duties:

Office of Chief of Section.
Accounting Subsection.
Mails and Files Subsection.
Supplies and Property Subsection.

Office of Director of Air Regulation. The Office of the Director of Air Regulation has charge of all matters dealing with the licensing, inspection, and other regulation of aircraft. It is divided into the following units:

Inspection Service.
Licensing Division.
Engine Testing Unit.

Inspection Service. The Inspection Service is responsible for the inspection of aircraft, the examining of airmen, the investigation of aircraft accidents, the enforcing of the air traffic rules and air commerce regulations, the inspection and rating of aeronautical schools, and the testing of new types of aircraft. This is a field unit and operates under the direct supervision of the Director of Air Regulation. For convenience in handling this work, the country has been divided into nine districts, each in the charge of a Supervising Aeronautical Inspector. The areas covered by the several districts and the headquarters of each are as follows:

District 1. Headquarters: Roosevelt Field, Garden City, Long Island, New York.
Maine, New Hampshire, Vermont, Connecticut, Massachusetts, Rhode Island, New York, New Jersey, except Camden.

District 2. Headquarters: Central Airport, Camden, New Jersey.
City of Camden, Pennsylvania, Delaware, Maryland, District of Columbia, Virginia, West Virginia.

District 3. Headquarters: Municipal Airport, Atlanta, Georgia.
Tennessee, North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, Louisiana east of Mississippi River.

District 4. Headquarters: Detroit, Michigan.
Michigan, Ohio, Indiana, Kentucky.

District 5. Headquarters: Municipal Airport, 5932 South Cicero Avenue, Chicago, Illinois.
Illinois, Wisconsin, Minnesota, Iowa, North Dakota, South Dakota.

District 6. Headquarters: Kansas City, Missouri.
Missouri, Nebraska, Kansas, Colorado.

District 7. Headquarters: Army Airways, Love Field, Dallas, Texas.
Texas, except El Paso, Oklahoma, Arkansas, Louisiana west of Mississippi River.

District 8. Headquarters: Oakland Airport, Oakland, California.
Northern California, Nevada, Utah, Washington, Oregon, Montana, Idaho, Wyoming.

District 9. Headquarters: Los Angeles, California.
Southern California, Arizona, New Mexico, City of El Paso, Texas.

Licensing Division. The Licensing Division is responsible for the preparation of Air Commerce Regulations and Air Traffic Rules and for the performance of all other regulatory work conferred on the Secretary of Commerce by the Air Commerce Act. These include the licensing of aircraft and airmen, the checking and approval of technical data on new types of aircraft, aircraft engines, and propellers, the physical examining of pilots, the analysis of aircraft accident data, and the legal phases of the regulatory work. The work is carried on through the following sections:

Engineering Section.
Registration Section.
Medical Section.
Legal Section.
Accident Board.

The Engineering Section passes on all matters dealing with the structural features of airplanes, as no aircraft are licensed until the Engineering Section issues what is known as an approved type certificate, which indicates that the design of the aircraft has the approval of the Aeronautics Branch.

In order to obtain an approved type certificate, the manufacturer must first submit complete technical data, stress analyses, and blue-prints of his aircraft; these are carefully checked by the Engineering Section to make sure that the design of the structure falls within the required margin of safety and adheres to accepted engineering practice. This, however, does not mean that a radical or new type of design cannot be approved, as such a type may be approved if the structure is justified by mathematical computation and physical tests. When the Engineering Section has approved the design, the manufacturer is required to present a standard machine for inspection. One or more of the engineering inspectors are then sent to the factory. The airplane is examined to determine that it is built according to the design submitted; it is checked for detailed design, workmanship and materials, and is weighed and thoroughly flight-tested, to make sure that it has no undesirable flying characteristics and satisfies the stability requirements of the Department. The factory is also inspected to determine whether it is suitably equipped and manned to produce aircraft exactly similar to the design submitted. When the structural check, practical flight test, and factory inspection are satisfactorily completed, the manufacturer is given an approved type certificate for this particular model. This type of plane is then approved for license so long as the workmanship, materials, and design are adhered to, a check on the workmanship, materials and design being made by airplane inspectors who are located at all principal factories for the purpose of minutely looking after such fabrication details.

The Registration Section has charge of the clerical details in connection with the issuance and renewal of licenses for aircraft, pilots, and mechanics, of the records pertaining to transfer of title, and of the assignment of identification marks, as well as the issuance of certificates of airworthiness for export. Its work is largely formal, as the practical and theoretical examination of pilots and mechanics and the inspection of aircraft are done by the personnel of the Inspection Service, while the physical examination of pilots forms the work of the Medical Section.

Its work is divided into the following subunits:

Office of Chief of Section.
Applications Subsection.
Files Subsection.
Pilots and Mechanics Subsection.
Licensed Aircraft Subsection.
Sales and Transfer Subsection.
Liaison Subsection.

The physical examination of applicants for pilots' licenses is made under the direction of the Medical Section. The physical examinations are made by physicians throughout the country who are commissioned as examiners, and compensated on a fee basis. On October 31, 1929, there were 672 physicians commissioned as examiners.

The Legal Section considers all reports of violations received from the Inspection Division or other sources, and makes recommendation to the Secretary of Commerce regarding the disciplinary measures that should be taken or the civil penalty that should be assessed. As in the case of the water navigation laws, the statute prescribes a uniform penalty for all violations, but the Secretary of Commerce has the power to remit the penalty entirely or in part.

In addition to the consideration of violations the Legal Section also handles all legal matters, including the drafting of legislation.

The Accident Board is an ex-officio unit which analyzes civil aircraft accidents and endeavors to ascertain their causes. It is composed of two pilots from the Inspection Service, a flight surgeon from the Medical Section, a lawyer from the Enforcement Section, and an aeronautical engineer from the Engineering Section, all of whom have other duties and give only a part of their time to the work of the Board. Prior to the meeting of the Board reports on accidents are analyzed in detail by the Statistical Assistant, who makes a preliminary classification of all contributing factors and arranges the material for consideration of the Board.

Office of Director of Aeronautic Development. The Office of Director of Aeronautic Development has charge of technical research, the dissemination of information, the rating of airports, and the publication of maps. It is divided into the following units:

Aeronautic Information Division.
Airport Section.
Airways Mapping Section (Coast and Geodetic Survey).
Aeronautic Research Division (Bureau of Standards).

Aeronautic Information Division. The Aeronautic Information Division has charge of the compilation and distribution of information, except on airports. It is divided into the following units:

Editorial Section.
Statistics and Distribution Section.
Airway Bulletin Section.
Aeronautics Reference Library.

The work of the Editorial Section includes the preparation of the Air Commerce Bulletin, a semi-monthly publication devoted to the work of the Aeronautics Branch and the development of aviation, the writing of articles and editorials relating to all phases of aeronautics, and the preparation of all press releases.

The Airway Bulletin Section prepares the Airway Bulletins, maintains a list of all airports and landing fields, and conducts the correspondence appertaining thereto.

The Statistics and Distribution Section compiles all statistical data relating to the work of the Aeronautics Branch, including accidents and general aeronautic problems. The analyses of accident statistics cover both the causes of accidents and the extent of injury to machines and personnel. Statistics are tabulated by six-month periods. The method used in analyzing the statistics is given in Report No. 308 of the National Advisory Committee for Aeronautics entitled "Aircraft Accidents."

This section distributes publications, answers all requests

for general information, and keeps a file of general miscellaneous information regarding aeronautic industry.

Airport Section. The Airport Section, which reports directly to the Director of Aeronautic Development, handles all matters relating to airports, including the planning of airports, their rating, and the distribution of information.

Airways Mapping Section (Coast and Geodetic Survey). The Airways Mapping Section, which also reports directly to the Director of Aeronautic Development, has charge of the mapping of the airways. The work is done by the Coast and Geodetic Survey, a bureau of the Department of Commerce, one of its units functioning as the Airway Mapping Section of the Aeronautics Branch. In most areas the topographic maps of the Geological Survey, a branch of the Department of the Interior, furnish data from which may be compiled the base as regards the general topographic features. There must be added to this base the course of flight, the location of beacons, landing fields, airports, transmission lines, and other data not shown on ordinary topographic maps.

The base is compiled in the Airways Mapping Section, whose field personnel fly over the course in order to obtain the additional data. The execution of the engraving and printing of the maps is done in the regular map engraving plant of the Coast and Geodetic Survey.

Airways Division (Bureau of Lighthouses). The Airways Division is an operating unit which has charge of all matters relating to the installation and maintenance of aids to air navigation. It is administered by the Bureau of Lighthouses of the Department of Commerce. In general matters of policy the control is exercised by the Aeronautics Branch, but all details of routine administration are in the hands of the Commissioner of Lighthouses. It is organized into the following sections:

Survey Section.
Construction Section.
Weather and Communications Section.
Radio Section.

In the maintenance and operation of aids to navigation,

except in the Plains, Great Basin, and Rocky Mountain regions, the regular field force of the Lighthouse Service is utilized with the addition of special personnel. The other work of the division is carried on by the sections listed above which are engaged exclusively on aids to air navigation. They are administratively under the Bureau of Lighthouses, and utilize the overhead administrative units of that bureau in matters of routine administration.

All the personnel devoting their time entirely to aeronautic matters are paid from the appropriations of the Aeronautics Branch, which are also charged with the cost of supplies, material, and miscellaneous expenses. The directing personnel devoting time to both lighthouse and aeronautic work is paid from the appropriations made to the Lighthouse Service; some of the members of the subordinate administrative personnel devoting time to both services are paid from Aeronautics Branch appropriations in order to effect an equalization.

The first unit concerned with the development of aids to air navigation is the Survey Section. After the terminal points of an airway are decided upon, the Survey Section fixes the route, selects sites for beacons and intermediate fields, makes necessary arrangements for leasing the sites and fields, and arranges for placing the fields in condition for use by aircraft.

While airways on the whole follow a straight line between the two terminals, there are locations where it is desirable to deviate from a straight course. The preferable location is in level open country, where roads and railroads offer important guides for day flying. An endeavor is made to avoid heavily wooded and mountainous country and electric power lines. The route is first studied from the air, and later a ground survey is made to obtain additional details.

The field work of the Survey Section shifts from place to place in accordance with the development of new airways, and the number of units in the field varies with the number of airways being surveyed.

All facilities used as aids to air navigation are designed and installed by or under the direction of the Construction

Section, except that the conditioning of intermediate fields is done under the direction of the Survey Section, and the design of radio equipment is made by the Radio Section. The installations under the control of the Construction Section include beacons, markers on intermediate fields, and radio station structures.

The field work of the Construction Section shifts from place to place as the new aids to air navigation are installed.

The Weather and Communications Section has charge of the establishment and operation of airways weather reporting stations not controlled by the Weather Bureau and airways communication stations. On July 1, 1929, it operated 59 weather reporting stations and 37 airways communication stations on civil airways, with a field personnel of 140.

The Radio Section designs and operates the radio equipment used on the airways to communicate with aircraft in flight. On July 1, 1929, radio range stations were operated at the following points:

Atlanta, Georgia.
Bellefonte, Pennsylvania.
Boston, Massachusetts.
Bryan, Ohio.
Burley, Idaho.
Cheyenne, Wyoming.
Cleveland, Ohio.
Des Moines, Iowa.[1]
Elko, Nevada.
Fort Worth, Texas.
Goshen, Indiana.[1]
Greensboro, North Carolina.
Hadley Field, New Jersey.
Iowa City, Iowa.
North Kansas City, Missouri.
Key West, Florida.
La Crosse, Wisconsin.
Glendale, California.
Maywood (Chicago), Illinois.
Medford, Oregon.
Moline, Illinois.
North Platte, Nebraska.
Oakland, California.
Oklahoma City, Oklahoma.
Omaha, Nebraska.
Portland, Oregon.
Reno, Nevada.
Richmond, Virginia.
Rock Springs, Wyoming.
St. Louis, Missouri.
Salt Lake City, Utah.
Seattle, Washington.
Spartanburg, South Carolina.
Sterling, Illinois.
Strevill, Idaho.
Washington, District of Columbia.
Wichita, Kansas.

[1] Beacon stations.

Stations for radio communication to aircraft in flight were operated as follows:

Bellefonte, Pennsylvania.
Bryan, Ohio.
Cheyenne, Wyoming.
Cleveland, Ohio.
Elko, Nevada.
Fresno, California.
Hadley Field, New Jersey.
Iowa City, Iowa.
North Kansas City, Missouri.
Key West, Florida.
La Crosse, Wisconsin.
Glendale, California.
Maywood, Illinois.
Medford, Oregon.
North Platte, Nebraska.
Oakland, California.
Omaha, Nebraska.
Portland, Oregon.
Reno, Nevada.
Rock Springs, Wyoming.
St. Louis, Missouri.
Salt Lake City, Utah.
Seattle, Washington.
Wichita, Kansas.

The operation of all beacon lights and their repair, except in the Plains, Great Basin, and Rocky Mountain Area, is under the direction of the district offices of the Lighthouse Service, to which are assigned airways engineers, who work under the general supervision of the lighthouse superintendents of the several districts. The superintendents of the district offices of the Lighthouse Service report directly to the Chief Engineer of the Airways Division in all matters relating to the work connected with the lighting of airways.

The lighthouse districts engaged in this work and the airways under each one on October 15, 1929, were as follows:

Third Lighthouse District, headquarters, Staten Island, New York:
- New York-Boston Airway.
- Bellefonte-New York section of Chicago-New York Airway.
- Richmond-New York section of Atlanta-New York Airway.
- New York-Montreal Airway.

Sixth Lighthouse District, headquarters, Charleston, South Carolina:
- Atlanta-Richmond section of Atlanta-New York Airway.
- Jacksonville-Atlanta section of Miami-Atlanta Airway.
- Selma (Alabama)-Atlanta section of New Orleans-Atlanta Airway.
- Atlanta-Evansville section of Atlanta-Chicago Airway.

Tenth Lighthouse District, headquarters, Buffalo, New York:

Bryan (Ohio)-Bellefonte section of Chicago-New York Airway.
Louisville-Cleveland Airway.
Cleveland-Detroit Airway.
Cleveland-Albany Airway.
Cincinnati-Indianapolis section of Cincinnati-Chicago Airway.
Indianapolis-Dayton section of St. Louis-Columbus Airway.
Pittsburgh-Cleveland section of Washington-Cleveland Airway.

Twelfth Lighthouse District, headquarters, Milwaukee, Wisconsin:

Chicago-Twin Cities Airway.
Chicago-Bryan section of Chicago-New York Airway.
Indianapolis-Chicago section of Cincinnati-Chicago Airway.
Evansville-Chicago section of Atlanta-Chicago Airway.
St. Louis-Chicago Airway.
Kansas City-Chicago Airway.
Omaha-Chicago Airway.
Kansas City-Omaha Airway.
Kansas City-St. Louis Airway.
St. Louis-Evansville Airway.
Milwaukee-Green Bay Airway.
Michigan Airways.

Seventeenth Lighthouse District, headquarters, Portland, Oregon:

Medford-Seattle section of San Francisco-Seattle Airway.

Eighteenth Lighthouse District, headquarters, San Francisco, California:

Los Angeles-Las Vegas section of Los Angeles-Salt Lake City Airway.
Los Angeles-San Francisco Airway.
San Francisco-Medford section of San Francisco-Seattle Airway.
San Francisco-Reno section of San Francisco-Salt Lake City Airway.

Airways Engineer, Fort Worth, Texas:

Dallas-Kansas City Airway.
Tulsa-Ponca City Airway.

Gallup-Albuquerque section of Los Angeles-Albuquerque Airway.
Albuquerque-Wichita Airway.
Waco-Fort Worth Airway.

Airways Engineer, Salt Lake City, Utah:
Salt Lake City-Omaha Airway.
Salt Lake City-Great Falls Airway.
Salt Lake City-Pasco Airway.
Reno-Salt Lake City section of San Francisco-Salt Lake City Airway.
Las Vegas-Salt Lake City section of Los Angeles-Salt Lake City Airway.
Pueblo-Cheyenne Airway.

As the Great Basin, Rocky Mountain and Plains regions are not conveniently located with reference to the Lighthouse Service organization, separate offices have been established at Fort Worth and Salt Lake City to look after the work.

Aeronautics Research Division (Bureau of Standards). The Air Commerce Act gives specific power to the Secretary of Commerce to "advise with the Bureau of Standards and other agencies in the executive branch of the Government in carrying forward such research and development work as tends to improve air navigation facilities." The act further authorizes the Secretary to transfer funds to agencies carrying forward such research and development work. Recent acts making appropriations for the Bureau of Standards have contained the provision that funds for research work may be transferred to that bureau by the head of any department.

To carry on the research work necessary for the development of commercial aeronautics the Aeronautics Research Division has been established in the Bureau of Standards, the Assistant Director of the bureau in charge of research and testing acting as Chief of the Division.

The investigations to be undertaken are specified by the Director of Aeronautics, but both the technical and administrative details of the work are under the control of the Director of the Bureau of Standards to the same extent as the other activities of the bureau. The cost of the work is charged to the appropriations for the Aeronautics Branch.

The Aeronautics Research Division is organized into the following sections:

Radio Section.
Lighting Section.
Aircraft Engine Section.
Engineering Section.

During the fiscal year 1928 the major investigations undertaken by the several sections were as follows: Radio aids to air navigation, by the Radio Section; lighting of airways, by the Lighting Section; sound-proofing of airplane cabins and welding of joints in tubular members of aircraft, by the Engineering Section; tests of aircraft engines, by the Aircraft Engine Section.

In addition to the main laboratory at the plant of the Bureau of Standards in Washington, work is carried on at field stations at Arlington, Virginia, and Bellefonte, Pennsylvania.

Co-ordination with National Advisory Committee for Aeronautics. The work of the Aeronautics Research Division is correlated with that of the National Advisory Committee for Aeronautics by means of co-ordinating committees.

The National Advisory Committee for Aeronautics is composed of fifteen members, who serve without compensation. The law provides that the Committee shall consist of two members each from the offices in charge of aeronautics of the War Department and the Navy Department, one representative each from the Weather Bureau, the Bureau of Standards, and the Smithsonian Institution, and additional persons acquainted with the needs of aeronautical science or skilled in aeronautical engineering or its allied sciences. The committee is appointed by the President, the present members and the fiscal year in which they were appointed being as follows:

War Department:
Major James E. Fechet, Chief of Air Corps. 1928.
Brig. Gen. Benjamin D. Foulois, Chief of Material Division, Army Air Corps. 1929.

Navy Department:
Rear Admiral William A. Moffett, Chief of Bureau of Aeronautics. 1921.
Commander John H. Towers, Assistant Chief of Bureau of Aeronautics. 1929.

Weather Bureau:
Charles F. Marvin, Chief of Bureau. 1915.

Smithsonian Institution:
Charles G. Abbot, Secretary. 1928.

Bureau of Standards:
George K. Burgess, Director. 1923.

Additional members:
Joseph S. Ames, Johns Hopkins University. 1915.
William F. Durand, Leland Stanford Jr. University. 1915.
S. W. Stratton, Massachusetts Institute of Technology. 1915.
David W. Taylor, United States Navy, retired. 1917.
Orville Wright. 1920.
Harry F. Guggenheim. 1929.
William P. McCracken, Jr., formerly Assistant Secretary of Commerce for Aeronautics. 1929.
Edward P. Warner. 1929.

The last three were appointed to original vacancies through increase in membership.

The heads of the Weather Bureau, the Bureau of Standards, and the Smithsonian Institution have always been members of the committee. The Army and the Navy representatives have changed as changes were made in the organization of these services or as officers were retired or assigned to duty outside of Washington. Other members who are no longer on the committee served as follows: John F. Hayford, 1915-1923; Byron R. Newton, 1915-1918; Michael I. Pupin, 1915-1922; John R. Freeman, 1918-1919. Dr. Stratton and Rear Admiral Taylor originally were appointed as official members. After Dr. Stratton resigned from the Bureau of Standards and after Admiral Taylor was retired from active duty, they were appointed as additional members.

The National Advisory Committee ordinarily meets twice a year. The carrying out of the work of the National

Advisory Committee is entrusted to an Executive Committee consisting of seven members, and in addition any member of the National Committee resident in or near Washington giving his time wholly or chiefly to the field of aeronautics. The Executive Committee, in accordance with the general instructions of the National Advisory Committee, exercises the functions prescribed by law for the whole committee, administers the affairs of the committee, and exercises general supervision over all its activities. The Executive Committee has organized nine standing committees, which in turn have subcommittees, as follows:

1. Committee on Aerodynamics:
   1. Subcommittee on Airships.
   2. Subcommittee on Aeronautical Research in Universities.
2. Committee on Power Plants for Aircraft.
3. Committee on Materials for Aircraft.
   1. Subcommittee on Metals.
   2. Subcommittee on Woods and Glue.
   3. Subcommittee on Coverings, Dopes, and Protective Coatings.
   4. Subcommittee on Aircraft Structures.
4. Committee on Problems of Air Navigation:
   1. Subcommittee on Problems of Communications.
   2. Subcommittee on Instruments.
   3. Subcommittee on Meteorological Problems.
5. Committee on Aircraft Accidents.
6. Committee on Aeronautical Inventions and Designs.
7. Committee on Publications and Intelligence.
8. Committee on Personnel, Buildings, and Equipment.
9. Committee on Governmental Relations.

The personnel of the committees and subcommittees includes members and staff of the National Advisory Committee, persons connected with research and aviation operating agencies of the Government, and representatives of the industries which supply material to the aircraft industry. The functions of the several committees are as follows:

Committee on Aerodynamics:

1. To determine what problems in theoretical and experimental aerodynamics are the most important for investigation by governmental and private agencies.

2. To co-ordinate by counsel and suggestion the research work involved in the investigation of such problems.
3. To act as a medium for the interchange of information regarding aerodynamic investigations and developments, in progress or proposed.
4. To direct and conduct research in experimental aerodynamics in such laboratory or laboratories as may be placed either in whole or in part under its direction.

Committee on Power Plants for Aircraft:

1. To determine which problems in the field of aeronautic power-plant research are the most important for investigation by governmental and private agencies.
2. To co-ordinate by counsel and suggestion the research work involved in the investigation of such problems.
3. To act as a medium for the interchange of information regarding aeronautic power-plant research in progress or proposed.
4. To direct and conduct research on aeronautic power-plant problems in such laboratories as may be placed either in whole or in part under its direction.

Committee on Materials for Aircraft:

1. To aid in determining the problems relating to materials for aircraft to be solved experimentally by governmental and private agencies.
2. To endeavor to co-ordinate, by counsel and suggestion, the research and experimental work involved in the investigation of such problems.
3. To act as a medium for the interchange of information regarding investigation of materials for aircraft in progress or proposed.
4. To direct and conduct research and experiment on materials for aircraft in such laboratory or laboratories, either in whole or in part, as may be placed under its direction.

Committee on Problems of Air Navigation—To co-ordinate fundamental scientific research on the problems of air navigation.

Committee on Aircraft Accidents—To establish a nomenclature, subdivision, and classification of aircraft accidents for the purpose of preparing a basis for the classification of aircraft accidents, both civil and military.

Committee on Aeronautical Inventions and Designs—To consider such inventions or designs as are deemed by the Director of Aeronautical Research to be worthy of favorable recommendation to the Aeronautical Patents and Design Board or as he desires to bring to the attention of the committee for its action. The Director of Aeronautical Research is authorized to submit any unfavorable recommendations direct to the Aeronautical Patents and Design Board, but any favorable recomendations must be considered and made by the Committee on Aeronautical Inventions and Designs.

Committee on Publications and Intelligence:

1. The collection, classification, and diffusion of technical knowledge on the subject of aeronautics, including the results of research and experimental work done in all parts of the world.
2. The encouragement of the study of the subject of aeronautics in institutions of learning.
3. Supervision of the Office of Aeronautical Intelligence, whose functions are "the collection, classification, and diffusion of technical knowledge on the subject of aeronautics to the military and naval air services, aircraft manufacturers, educational institutions, and others interested, including the results of research and experimental work conducted in all parts of the world."
4. Supervision of the committee's foreign office in Paris.
5. The collection and preparation for publication of the Technical Reports, Technical Notes, Technical Memorandums, and Aircraft Circulars of the committee.

Committee on Personnel, Buildings, and Equipment:

1. To handle all matters relating to personnel, including the employment, promotion, discharge, and duties of all employees.
2. To consider questions referred to it and make recommendations regarding the initiation of projects concerning the erection or alteration of laboratories and offices.
3. To supervise such construction and equipment work as may be authorized by the Executive Committee.

Committee on Governmental Relations:

1. Relations of the committee with executive departments and other branches of the Government.
2. Governmental relations with civil agencies.

General responsibility for the execution of the policies and the direction of the activities as approved by the Executive Committee is vested in the Director of Aeronautical Research. He has immediate charge of the scientific and technical work of the committee, being directly responsible to the Chairman of the Executive Committee. The secretary, who is not a member of the committee, is ex-officio secretary of the Executive Committee, directs the administrative work of the organization, and exercises general supervision over the expenditures of funds and the employment of personnel.

The administrative headquarters of the committee are at Washington, but the greater part of its work is done at the Langley Aeronautical Laboratory at Langley Field, Virginia, on a plot of ground set aside by the War Department for this purpose.

The laboratory is organized with five divisions, as follows: Aerodynamics division, power plants division, technical service division, flight operations division, and property and clerical division. The administration of the laboratory is under the immediate direction of an engineer in charge, subject to the supervision of the officers of the committee.

The laboratory consists of seven buildings—a research laboratory building, containing the administrative offices, the technical library, the photographic laboratory, and the headquarters of the aerodynamics, power plants, technical service, and flight operations divisions; two aerodynamical laboratories, one containing a wind tunnel of the standard type and the other a variable-density wind tunnel, each laboratory being complete in itself; two engine dynamometer laboratories of a semi-permanent type, both equipped to carry on investigations in connection with power plants for aircraft; an airplane hangar with a repair shop and facilities for taking care of airplanes used in flight research; and a service building, containing an instrument laboratory, drafting room, machine and woodworking shops, and storeroom.

In addition to the above, the laboratory equipment includes a propeller research tunnel in which a velocity of 100 miles per hour may be obtained in a 20-foot air stream.

An office in Paris is maintained for the purpose of obtaining information.

In addition an appreciable amount of research is done for the committee by the Bureau of Standards and the Forest Products Laboratory of the Forest Service, which are specially qualified and equipped for some of the problems under consideration.

The expenditures at the several units during the fiscal year 1927 were as follows:

Washington Office, including Office of Aeronautical Intelligence and printing of publications	$89,228.02
Langley Field Laboratory	386,866.52
Paris Office	13,903.45
Bureau of Standards	34,900.00
Forest Products Laboratory	2,500.00
Leland Stanford Junior University	1,900.00
Total	$529,297.99

APPENDIX 1

OUTLINE OF ORGANIZATION

Explanatory Note

The purpose of the Outlines of Organization in this series of Monographs is to show in detail the organization and personnel of the several services of the national government to which they relate. They have been prepared in accordance with the plan followed by the President's Commission on Economy and Efficiency in its outlines of the organization of the United States government.[1] They differ from those outlines, however, in that whereas the Commission's report showed only organization units, the presentation herein has been carried far enough to show the personnel embraced in each organization unit.

These outlines are of value not merely as an effective means of making known the organization of the several services. If kept revised to date, they constitute exceedingly important tools of administration. They permit the directing personnel to see at a glance the organization and personnel at their disposal. They establish definitely the line of administrative authority and enable each employee to know his place in the system. They furnish the essential basis of plans for determining costs by organization division and sub-division. They afford the data for a consideration of the problem of classifying and standardizing personnel and compensation. Collectively they make it possible to determine the number and location of organization units of any particular kind, such as laboratories, libraries, blueprint rooms, or other plants, to what services attached and where located, or to determine what services are maintaining stations at any city or point in the United States. The Institute hopes that upon the completion of the present

[1] 62 Cong., H. doc. 458, 1912, 2 vols.

series, it will be able to prepare a complete classified statement of the technical and other facilities at the disposal of the government. The present monographs will then furnish the details regarding the organization, equipment, and work of the institution so listed and classified.

OUTLINE OF ORGANIZATION
AERONAUTICS BRANCH
DEPARTMENT OF COMMERCE
January, 1930

Units of Organization: *Classes of Employees*	*Number*	*Salary Rate*
1. Office of Assistant Secretary for Aeronautics		
1. Immediate Office of Assistant Secretary		
Assistant Secretary	1	$9,000
Secretary to Assistant Secretary	1	3,000
Clerk	1	2,040
Messenger	1	1,200
2. Office of the Director of Air Regulation		
1. Immediate Office of Director of Air Regulation		
Director	1	7,000
Secretary	1	2,100
2. Inspection Service		
1. Office of Chief of Service		
Chief of Service	1	5,000
Assistant Chief of Service	2	4,600 and 4,800
Aeronautical Engineering Inspector	9	4,000 to 4,400
Aeronautical School Inspector	4	4,200 to 4,400
Supervising Airplane Inspector	1	3,000
Airplane Mechanic	4	1,260 to 2,500
Clerk	4	1,260 to 1,740
2. Office of Supervising Aeronautical Inspector, District No. 1, Garden City, New York.		
Supervising Aeronautical Inspector	1	4,400
Aeronautical Inspector	5	3,500 to 3,800
Airplane Inspector	3	2,600 to 2,800
Clerk	1	1,500
3. Office of Supervising Aeronautical Inspector, District No. 2, Camden, New Jersey		
Supervising Aeronautical Inspector	1	4,400
Aeronautical Inspector	3	3,700 to 4,000
Clerk	1	1,440

Units of Organization: Classes of Employees	*Number*	*Salary Rate*
4. Office of Supervising Aeronautical Inspector, District No. 3, Atlanta, Georgia		
Supervising Aeronautical Inspector	1	4,200
Aeronautical Inspector	4	3,500 to 3,800
Clerk	1	1,440
5. Office of Supervising Aeronautical Inspector, District No. 4, Detroit, Michigan		
Supervising Aeronautical Inspector	1	4,200
Aeronautical Inspector	5	3,700 to 4,000
Airplane Inspector	2	2,600 and 2,800
Clerk	1	1,740
6. Office of Supervising Aeronautical Inspector, District No. 5, Chicago, Illinois		
Supervising Aeronautical Inspector	1	4,400
Aeronautical Inspector	5	3,500 to 3,800
Airplane Inspector	1	3,000
Clerk	1	1,800
7. Office of Supervising Aeronautical Inspector, District No. 6, Kansas City, Missouri		
Supervising Aeronautical Inspector	1	4,200
Aeronautical Inspector	4	3,500 to 4,000
Airplane Inspector	5	2,600 to 3,000
Clerk	1	1,620
8. Office of Supervising Aeronautical Inspector, District No. 7, Dallas, Texas		
Supervising Aeronautical Inspector	1	4,400
Aeronautical Inspector	3	3,500 to 4,000
Airplane Inspector	1	2,800
Clerk	1	1,620
9. Office of Supervising Aeronautical Inspector, District No. 8, Oakland, California		
Supervising Aeronautical Inspector	1	4,400
Aeronautical Inspector	5	3,800 to 4,000
Clerk	1	1,620

Units of Organization: *Classes of Employees*	*Number*	*Salary Rate*
10. Office of Supervising Aeronautical Inspector, District No. 9, Los Angeles, California		
Supervising Aeronautical Inspector	1	4,400
Aeronautical Inspector	4	3,800 to 4,000
Clerk	2	1,620 and 2,600
3. Licensing Division		
1. Office of Chief of Division		
Chief of Division	1	5,000
Clerk	1	1,800
2. Registration Section		
1. Office of Chief of Section		
Chief of Section	1	3,300
Assistant Chief of Section	1	2,300
Clerk	4	1,400 to 2,000
2. Applications Subsection		
Clerk in Charge	1	1,620
Clerk	6	1,260 to 1,440
3. Files Subsection		
Clerk in Charge	1	1,800
Clerk	6	1,260 to 1,440
4. Pilots and Mechanics Subsection		
Clerk in Charge	1	1,740
Clerk	6	1,260 to 1,560
5. Licensed Aircraft Subsection		
Clerk in Charge	1	1,620
Clerk	6	1,260 to 1,440
6. Sales and Transfers Subsection		
Clerk in Charge	1	1,980
Clerk	5	1,440 to 1,740
7. Liaison Subsection		
Clerk in Charge	1	1,680
Clerk	2	1,260 and 1,440
3. Medical Section		
Chief of Section	1	6,400
Assistant Chief of Section	1	4,800
Clerk	7	1,260 to 2,040
4. Accident Board		
Chief of Board	1	3,200
Clerk	4	1,440 to 1,800
5. Legal Section		
Chief of Section	1	4,000
Assistant Chief of Section	1	2,500
Clerk	1	1,860

Units of Organization: *Classes of Employees*	*Number*	*Salary Rate*
6. Engineering Section		
Chief of Section	1	8,000
Assistant Chief of Section	1	4,600
Aeronautical Engineer	9	2,200 to 3,600
Clerk	5	1,260 to 1,920
4. Engine Testing Unit (Bureau of Standards)		
Chief of Section	1	4,600
Airplane Engineering Inspector	1	2,600
Engineer	7	2,000 to 3,200
Laboratory Mechanic	11	1,020 to 2,400
Clerk	1	1,860
Laborer	2	1,080
3. Office of Director of Aeronautic Development		
1. Immediate Office of Director		
Director of Aeronautic Development	1	7,000
Secretary to Director	1	2,000
2. Aeronautic Information Division		
1. Office of Chief of Division		
Chief of Division	1	5,000
Secretary	1	2,100
2. Airway Bulletin Section		
Chief of Section	1	2,800
Draftsman	5	1,620 to 2,800
Clerk	6	1,440 to 1,920
3. Editorial Section		
Chief of Section	1	4,000
Clerk	2	1,440
4. Statistics and Distribution Section		
Chief of Section	1	2,800
Assistant Chief of Section	1	2,300
Clerk	10	1,260 to 1,800
5. Library		
Librarian	1	1,740
3. Airport Section		
Chief of Section	1	4,200
Airport Specialist	4	3,400 to 3,800
Clerk	2	1,620 and 1,860
4. Aeronautic Research Division (Bureau of Standards)		
1. Office of Chief of Division (Assistant Director of Bureau of Standards)		
Chief of Division	1	(1)

[1] Paid by Bureau of Standards.

Units of Organization: Classes of Employees	*Number*	*Salary Rate*
2. Radio Research Section		
Chief of Section	1	6,000
Scientist	1	4,000
Engineer	3	2,600 to 3,800
Mechanician	4	1,200 to 2,800
Test Pilot	1	3,200
Physicist	1	2,600
Laborer	2	1,200 and 1,500
Watchman	2	1,200
Mechanics Helper	2	630 and 1,020
3. Lighting Research Section		
Chief of Section	1	3,400
Scientist	1	2,100
Engineer	1	2,000
Laborer	1	1,200
4. Aircraft Engine Section		
Chief of Section	1	4,200
Airplane Engine Inspector	1	2,600
Mechanician	8	1,440 to 2,600
Engineer	2	2,000 and 2,500
Laboratory Apprentice	2	1,020 and 1,320
5. Engineering Research Section		
Chief of Section	1	5,000
Scientist	1	2,500
Engineer	2	2,100
Machinist	1	2,040
Scientific Aid	1	1,740
6. Wind Tunnel Section		
Chief of Section	1	3,400
Engineer	1	2,100
Scientist	1	2,000
5. Airways Mapping Section (Coast and Geodetic Survey)		
Chief of Section	1	4,600
Draftsman	5	2,600 to 3,100
4. Airways Division (Bureau of Lighthouses)		
1. Office of Chief Engineer		
Chief Engineer	1	6,000
Assistant Chief Engineer	1	4,800
Administrative Officer	1	3,500
Clerk	8	1,440 to 2,400
Messenger	2	1,080
2. Survey Section		
Engineer in Charge	1	2,800
Airways Extension Superintendent	12	2,300 to 2,800
Airplane Mechanician	4	2,000 to 2,500
Engineer	4	2,200

Units of Organization: *Classes of Employees*	*Number*	*Salary Rate*
3. Construction Section		
Airways Engineer in Charge	1	4,800
Airways Engineer	3	2,900 to 3,800
Draftsman	3	1,800 to 2,100
Inspector of Airways Construction	12	2,600 to 3,100
Clerk	1	1,860
4. Radio Section		
Radio Engineer in Charge	1	4,600
Engineer	4	2,500 to 3,800
Electrician	4	2,000 to 2,500
Radio Operator	4	2,000 to 2,500
Clerk	1	1,740
5. Weather and Communications Section		
Radio Traffic Supervisor	1	3,800
Airways Extension Superintendent	1	3,700
Airways Engineer	1	2,900
6. Office of Superintendent of Third Lighthouse District, Staten Island, New York		
Superintendent	1	[2]
Airways Engineer	2	2,600 and 3,200
Airways Mechanician	6	2,000 to 2,500
Clerk	3	1,620 to 1,920
Full time Caretaker	6	600 to 1,500
Part time Caretaker	77	60 to 600
Weather Reporter	8	300 to 600
7. Office of Superintendent of Tenth Lighthouse District, Buffalo, New York		
Superintendent	1	[2]
Airways Engineer	2	2,700 to 3,300
Airways Mechanician	7	2,000 to 2,500
Clerk	3	1,620 to 1,920
Full time Caretaker	23	600 to 1,500
Part time Caretaker	19	60 to 600
Airways Keeper	5	1,500 to 1,800
8. Office of Superintendent of Eleventh Lighthouse District, Detroit, Michigan		
Superintendent	1	[2]
Radio Engineer	1	2,700
Radio Electrician	2	2,300
Clerk	2	1,440
9. Office of Superintendent of Twelfth Lighthouse District, Milwaukee, Wisconsin		
Superintendent	1	[2]

[2] Paid by Bureau of Lighthouses.

Units of Organization: *Classes of Employees*	*Number*	*Salary Rate*
Airways Engineer	6	2,600 to 3,800
Airways Mechanician	21	2,000 to 2,500
Electrician	1	2,400
Surveyor	1	2,400
Draftsman	1	2,000
Clerk	8	1,620 to 1,920
Laborer	1	1,680
Full time Caretaker	14	600 to 1,500
Part time Caretaker	256	60 to 600
Weather Reporter	7	300 to 600
10. Office of Superintendent of Seventeenth Lighthouse District, Portland, Oregon		
Superintendent	1	([3])
Airways Engineer	1	3,800
Airways Mechanician	1	2,000
Clerk	1	1,440
Part time Caretaker	2	60 and 600
11. Office of Superintendent of Eighteenth Lighthouse District, San Francisco, California		
Superintendent	1	([3])
Airways Engineer	3	2,800 to 3,400
Airways Mechanician	7	2,300
Clerk	2	1,620
Full time Caretaker	2	600 and 1,500
Part time Caretaker	85	60 to 600
12. Airways District Office, Salt Lake City, Utah		
Airways Engineer in Charge	1	4,800
Chief Clerk	1	3,100
Airways Engineer	2	2,700
Foreman Carpenter	1	2,500
Airways Mechanician	16	2,000 to 2,500
Inspector	3	2,300
Clerk	9	1,440 to 1,920
Draftsman	2	1,800 to 2,100
Electrician	3	2,000
Full time Caretaker	36	600 to 1,500
Part time Caretaker	81	60 to 600
Messenger	1	600
13. Airways District Office, Fort Worth, Texas		
Airways Engineer in Charge	1	4,600
Airways Engineer	2	2,600 to 3,200
Chief Clerk	1	2,900
Clerk	5	1,440 to 1,920

[3] Paid by Bureau of Lighthouses.

Units of Organization: *Classes of Employees*	*Number*	*Salary Rate*
Caretakers	1	1,320
Airways Mechanicians	6	2,300 to 2,800
5. Administrative Division		
1. Office of Chief of Division		
Chief of Division	1	4,000
Assistant Chief of Division	1	2,700
Clerk-Stenographer	1	1,920
2. Accounting Section		
Chief of Section	1	2,300
Clerk	6	1,440 to 1,740
3. Mail and Files Section		
Chief of Section	1	2,000
Assistant Chief	1	1,860
Clerk	7	1,260 to 1,620
4. Supplies and Property Section		
Clerk in Charge	1	1,860
Chauffeur	1	1,500
Messenger	5	600 to 1,320

APPENDIX 2

CLASSIFICATION OF ACTIVITIES

Explanatory Note

The Classifications of Activities in this series have for their purpose to list and classify in all practicable detail the specific activities engaged in by the several services of the national government. Such statements are of value from a number of standpoints. They furnish, in the first place, the most effective showing that can be made in brief compass of the character of work performed by the service to which they relate. Secondly, they lay the basis for a system of accounting and reporting that will permit the showing of total expenditures classified according to activities. Finally, taken collectively, they make possible the preparation of a general or consolidated statement of the activities of the Government as a whole. Such a statement will reveal in detail, not only what the Government is doing, but the services in which the work is being performed. It is hardly necessary to point out the value of such information in planning for future work and in considering the problem of the better distribution and co-ordination of the work of the Government. The Institute contemplates attempting such a general listing and classification of the activities of the Government upon the completion of the present series.

Classification of Activities

1. Licensing of aircraft.
2. Inspection of aircraft.
3. Supervision of marking of aircraft.
4. Licensing of pilots and mechanics.
5. Rating of instructors in flying schools.
6. Rating of flying schools.
7. Making air traffic rules.
8. Certification of aeronautic radio.

9. Enforcement of air traffic regulations.
10. Installation and maintenance of airways.
11. Distribution of information.
12. Rating of airports.
13. Analysis of accident statistics.
14. Research work.

APPENDIX 3

PUBLICATIONS

The publications of the Aeronautics Branch fall into the following classes:

1. Annual Reports.
2. Airway Bulletins.
3. Airway Maps.
4. Aeronautics Bulletins.
5. Air Commerce Bulletins (formerly Domestic Air News).
6. Unclassified Publications.

All the publications are distributed free except the Airway Maps, which are sold for 35 cents each.

The Annual Report gives an account of the work of the year, and contains also a review of the progress of the aeronautical industry, including statistics.

The Airway Bulletins are two-page leaflets, giving descriptions and plots of airports and surrounding territory. They are described on page 56. Up to January, 1930, over 800 bulletins had been issued.

Airway Maps show the topographic features of the airways; they are described on page 54. The maps issued to January, 1930, were as follows:

102.[1] Dallas-Oklahoma City.
103. Oklahoma City-Wichita.
104. Wichita-Kansas City.
105. Kansas City-Moline.
110. St. Louis-Chicago.
111. Chicago-Milwaukee.
115. Louisville-Cincinnati-Cleveland.
119. Buffalo-Albany.
127. Birmingham-Atlanta.

[1] The serial numbering begins with 101; the Army Air Corps map numbering begins with 1.

128. Atlanta-Greensboro.
129. Greensboro-Richmond.
130. Richmond-Washington.
131. Pueblo-Cheyenne.
132. Los Angeles-Las Vegas.
133. Las Vegas-Milford.
134. Milford-Salt Lake City.

The Aeronautics Bulletins include practically all the general publications which do not fall in the other series. Some of these were mimeographed, being issued without number and later having numbers assigned. In the beginning the title of the series was "Information Bulletins."

It should be noted that in each of two cases (Bulletins 14 and 20), two bulletins on different subjects and with different titles have been published with the same number; in the case of duplicate numbers the publication first listed below is no longer available for distribution.

The Aeronautics Bulletins issued to the end of 1929, were as follows:

1. Civil aeronautics in United States.
2. Construction of airports.
3. Aeronautics trade director (2 editions).
4. Air marking (2 editions, with slight variation in title).
5. Airports and landing fields (6 editions).
6. Aeronautics publications (3 editions, with slight variation in title).
7. Air commerce regulations.

7A. Airworthiness requirements.
7B. School supplement.

9. Air transport routes in operation.
10. Airway strip map list.
14. Requirements for approved type certificates.
14. Relative lift distribution in any biplane.
15. Air traffic rules.
16. Airport rating regulations.
17. Airport management.
18. State aeronautical legislation and compilation of State laws (2 editions, with slight variation in title).
19. Aviation training.

20. Directory of licensed pilots.
    Supp. 1. Supplement to directory of licensed pilots, October 1, 1928.
    Supp. 2. Supplement to directory of licensed pilots, November 1, 1928.
20. Suggested city or county aeronautics ordinance and uniform field rules for airports.

Air Commerce Bulletin is issued semi-monthly, the first issue being for July 1, 1929. It contains official notices to pilots, operators, and manufacturers of aircraft; air traffic rules; notices of suspension and revocation of licenses and registrations; statistics on operation; list of reserve air spaces set aside by the President; aeronautical lights certified; general notes on the progress of aviation at home and abroad; lists of air routes in operation; notes on progress of airway lighting, radio, and other aids to air navigation and other information deemed of timely importance to the aircraft industry and the public.

From late in 1926 to June 15, 1929, the same kind of material was published in Domestic Air News, a mimeographed publication. From February to June, 1927, Domestic Air News was issued monthly; from July 15, 1927, to June 15, 1929, it was published semi-monthly.

A series which has been discontinued was known as "Information Bulletins." All of these were not numbered, and some were printed and some mimeographed. Many have been reprinted in a later edition as Aeronautics Bulletins.

The unclassified publications are those which are not included in any of the series described above. Later editions of some of these have been issued as Aeronautics Bulletins. The publications which have not been republished in later series are as follows:

Report of Airway Marking Committee. 1929.
Physical standards for airplane pilots. 1928.
Proposed handbook for airplane designers. 1927.

APPENDIX 4

LAWS

There is only one law—the Air Commerce Act of 1926—which deals with the work undertaken by the Aeronautics Branch. All the powers and duties exercised by the Aeronautics Branch are conferred by law on the Secretary of Commerce.

(A) Synopsis of Laws

Air Commerce Act of 1926

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(B) Laws

1926—Act of May 20, 1926 (44 Stat. L., 568—An Act To encourage and regulate the use of aircraft in commerce, and for other purposes.

That as used in this Act, the term "air commerce" means transportation in whole or in part by aircraft of persons or property for hire, navigation of aircraft in furtherance of a business, or navigation of aircraft from one place to another for operation in the conduct

of a business. As used in this Act, the term "interstate or foreign air commerce" means air commerce between any State, Territory, or possession, or the District of Columbia, and any place outside thereof; or between points within the same State, Territory, or possession, or the District of Columbia, but through the airspace over any place outside thereof; or wholly within the airspace over any Territory or possession or the District of Columbia.

SEC. 2. PROMOTION OF AIR COMMERCE.—It shall be the duty of the Secretary of Commerce to foster air commerce in accordance with the provisions of this Act, and for such purpose—

(a) To encourage the establishment of airports, civil airways, and other air navigation facilities.

(b) To make recommendations to the Secretary of Agriculture as to necessary meteorological service.

(c) To study the possibilities for the development of air commerce and the aeronautical industry and trade in the United States and to collect and disseminate information relative thereto and also as regards the existing state of the art.

(d) To advise with the Bureau of Standards and other agencies in the executive branch of the Government in carrying forward such research and development work as tends to create improved air navigation facilities. The Secretary of Commerce is authorized to transfer funds available for carrying out the purposes of this subdivision to any such agency for carrying forward such research and development work in cooperation with the Department of Commerce.

(e) To investigate, record, and make public the causes of accidents in civil air navigation in the United States.

(f) To exchange with foreign governments through existing governmental channels information pertaining to civil air navigation.

SEC. 3. REGULATORY POWERS.—The Secretary of Commerce shall by regulation—

(a) Provide for the granting of registration to aircraft eligible for registration, if the owner requests such registration. No aircraft shall be eligible for registration (1) unless it is a civil aircraft owned by a citizen of the United States and not registered under the laws of any foreign country, or (2) unless it is a public aircraft of the Federal Government, or of a State, Territory, or possession, or of a political subdivision thereof. All aircraft registered under this subdivision shall be known as aircraft of the United States.

(b) Provide for the rating of aircraft of the United States as to their airworthiness. As a basis for rating, the Secretary of Commerce (1) may require, before the granting of registration for any aircraft first applying therefor more than eight months after the passage of this Act, full particulars of the design and of the calculations upon which the design is based and of the materials and methods used in the construction; and (2) may in his discretion accept in whole or in part the reports of properly qualified persons employed by the manufacturers or owners of aircraft; and (3) may require the periodic examination of aircraft in service and reports upon such examination by officers or employees of the Department of Commerce or by properly qualified private persons. The Secretary may accept any such examination and report by such qualified persons in lieu of examination by the employees of the Department of Commerce. The

qualifications of any person for the purposes of this section shall be demonstrated in a manner specified by and satisfactory to the Secretary. The Secretary may, from time to time, re-rate aircraft as to their airworthiness upon the basis of information obtained under this subdivision.

(c) Provide for the periodic examination and rating of airmen serving in connection with aircraft of the United States as to their qualifications for such service.

(d) [1] Provide for the examination and rating of air navigation facilities available for the use of aircraft of the United States as to their suitability for such use; and provide for the examination and rating of civilian schools giving instruction in flying, as to the adequacy of the course of instruction, as to the suitability and airworthiness of the equipment, and as to the competency of the instructors. The examinations and ratings provided for in this paragraph shall only be made upon request of the owners or representatives of the air navigation facilities or schools.

(e) Establish air traffic rules for the navigation, protection, and identification of aircraft, including rules as to safe altitudes of flight and rules for the prevention of collisions between vessels and aircraft.

(f) Provide for the issuance and expiration, and for the suspension and revocation, of registration, aircraft, and airman certificates, and such other certificates as the Secretary of Commerce deems necessary in administering the functions vested in him under this Act. Within 20 days after notice that application for any certificate is denied or that a certificate is suspended or revoked, the applicant or holder may file a written request with the Secretary of Commerce for a public hearing thereon. The Secretary upon receipt of the request shall forthwith (1) arrange for a public hearing to be held within 20 days after such receipt in such place as the Secretary deems most practicable and convenient in view of the place of residence of the applicant or holder and the place where evidence bearing on the cause for the denial, suspension, or revocation is most readily obtainable, and (2) give the applicant or holder at least ten days' notice of the hearing, unless an earlier hearing is consented to by him. Notice under this subdivision may be served personally upon the applicant or holder or sent him by registered mail. The Secretary, or any officer or employee of the Department of Commerce designated by him in writing for the purpose, may hold any such hearing and for the purposes thereof administer oaths, examine witnesses, and issue subpœnas for the attendance and testimony of witnesses, or the production of books, papers, documents, and other evidence, or the taking of depositions before any designated individual competent to administer oaths. Witnesses summoned or whose depositions are taken shall receive the same fees and mileage as witnesses in courts of the United States. All evidence taken at the hearing shall be recorded and forwarded to the Secretary for decision in the matter to be rendered not later than ten days after completion of the hearing. The decision of the Secretary, if in accordance with law, shall be final.

[1] As amended February 28, 1929 (45 Stat. L., 1404).

The denial, suspension, or revocation shall be invalid unless opportunity for hearing is afforded, notice served or sent, and decision rendered within the respective times prescribed by this subdivision.

SEC. 4. AIRSPACE RESERVATIONS.—The President is authorized to provide by Executive order for the setting apart and the protection of airspace reservations in the United States for national defense or other governmental purposes and, in addition, in the District of Columbia for public safety purposes. The several States may set apart and provide for the protection of necessary airspace reservations in addition to and not in conflict either with airspace reservations established by the President under this section or with any civil or military airway designated under the provisions of this Act.

SEC. 5. AIDS TO AIR NAVIGATION.—(a) Whenever at any time the Postmaster General and the Secretary of Commerce by joint order so direct, the airways under the jurisdiction and control of the Postmaster General, together with all emergency landing fields and other air navigation facilities (except airports and terminal landing fields) used in connection therewith, shall be transferred to the jurisdiction and control of the Secretary of Commerce, and the established airports and terminal landing fields may be transferred to the jurisdiction and control of the municipalities concerned under arrangements subject to approval by the President. All unexpended balances of appropriations which are available for and which have been allotted for expenditure upon such airways, emergency landing fields, and other air navigation facilities, except airports and terminal landing fields, shall thereupon be available for expenditure under the direction of the Secretary of Commerce, in lieu of the Postmaster General, for the purposes for which such appropriations were made. No part of such unexpended balances of appropriations shall be used for the purchase or establishment of airports or terminal landing fields.

(b) The Secretary of Commerce is authorized to designate and establish civil airways and, within the limits of available appropriations hereafter made by the Congress, (1) to establish, operate, and maintain along such airways all necessary air navigation facilities except airports; and (2) to chart such airways and arrange for publication of maps of such airways, utilizing the facilities and assistance of existing agencies of the Government so far as practicable. The Secretary of Commerce shall grant no exclusive right for the use of any civil airway, airport, emergency landing field, or other air navigation facility under his jurisdiction.

(c) Air navigation facilities owned or operated by the United States may be made available for public use under such conditions and to such extent as the head of the department or other independent establishment having jurisdiction thereof deems advisable and may by regulation prescribe.

(d) The head of any Government department or other independent establishment having jurisdiction over any airport or emergency landing field owned or operated by the United States may provide for the sale to any aircraft of fuel, oil, equipment, and supplies, and the furnishing to it of mechanical service, temporary shelter, and other assistance under such regulations as the head of the department or establishment may prescribe, but only if such action is by reason of an emergency necessary to the continuance of such aircraft on its

course to the nearest airport operated by private enterprise. All such articles shall be sold and such assistance furnished at the fair market value prevailing locally as ascertained by the head of such department or establishment. All amounts received under this subdivision shall be covered into the Treasury; but that part of such amounts which, in the judgment of the head of the department or establishment, is equivalent to the cost of the fuel, oil, equipment, supplies, services, shelter, or other assistance so sold or furnished shall be credited to the appropriation from which such cost was paid, and the balance, if any, shall be credited to miscellaneous receipts.

(e) Section 3 of the Act entitled "An Act to increase the efficiency and reduce the expense of the Signal Corps of the Army, and to transfer the Weather Service to the Department of Agriculture," approved October 1, 1890, is amended by adding at the end thereof a new paragraph to read as follows:

"Within the limits of the appropriations which may be made for such purpose, it shall be the duty of the Chief of the Weather Bureau, under the direction of the Secretary of Agriculture, (a) to furnish such weather reports, forecasts, warnings, and advices as may be required to promote the safety and efficiency of air navigation in the United States and above the high seas, particularly upon civil airways designated by the Secretary of Commerce under authority of law as routes suitable for air commerce, and (b) for such purposes to observe, measure, and investigate atmospheric phenomena, and establish meteorological offices and stations."

(f) Nothing in this Act shall be construed to prevent the Secretary of War from designating routes in the navigable airspace as military airways and prescribing rules and regulations for the use thereof on routes which do not conform to civil airways established hereunder, or to prevent the Secretary of Commerce from designating any military airway as a civil airway, and when so designated it shall thereupon become a civil airway within the meaning of this Act, and the Secretary of War is hereby authorized to continue the operation of air navigation facilities for any military airway so designated as a civil airway until such time as the Secretary of Commerce can provide for the operation of such facilities.

SEC. 6. FOREIGN AIRCRAFT.—(a) The Congress hereby declares that the Government of the United States has, to the exclusion of all foreign nations, complete sovereignty of the airspace over the lands and waters of the United States, including the Canal Zone. Aircraft a part of the armed forces of any foreign nation shall not be navigated in the United States, including the Canal Zone, except in accordance with an authorization granted by the Secretary of State.

(b) Foreign aircraft not a part of the armed forces of the foreign nation shall be navigated in the United States only if authorized as hereinafter in this section provided; and if so authorized, such aircraft and airmen serving in connection therewith, shall be subject to the requirements of section 3, unless exempt under subdivision (c) of this section.

(c) If a foreign nation grants a similar privilege in respect of aircraft of the United States, and/or airmen serving in connection therewith, the Secretary of Commerce may authorize aircraft registered under the law of the foreign nation and not a part of the

armed forces thereof to be navigated in the United States, and may by regulation exempt such aircraft, and/or airmen serving in connection therewith, from the requirements of section 3, other than the air traffic rules; but no foreign aircraft shall engage in interstate or intrastate air commerce.

SEC. 7. APPLICATION OF EXISTING LAWS RELATING TO FOREIGN COMMERCE.—(a) The navigation and shipping laws of the United States, including any definition of "vessel" or "vehicle" found therein and including the rules for the prevention of collisions, shall not be construed to apply to seaplanes or other aircraft or to the navigation of vessels in relation to seaplanes or other aircraft.

(b) The Secretary of the Treasury is authorized to (1) designate places in the United States as ports of entry for civil aircraft arriving in the United States from any place outside thereof and for merchandise carried on such aircraft, (2) detail to ports of entry for civil aircraft such officers and employees of the customs service as he may deem necessary, and to confer or impose upon any officer or employee of the United States stationed at any such port of entry (with the consent of the head of the Government department or other independent establishment under whose jurisdiction the officer or employee is serving) any of the powers, privileges, or duties conferred or imposed upon officers or employees of the customs service, and (3) by regulation to provide for the application to civil air navigation of the laws and regulations relating to the administration of the customs and public health laws to such extent and upon such conditions as he deems necessary.

(c) The Secretary of Commerce is authorized by regulation to provide for the application to civil aircraft of the laws and regulations relating to the entry and clearance of vessels to such extent and upon such conditions as he deems necessary.

(d) The Secretary of Labor is authorized to (1) designate any of the ports of entry for civil aircraft as ports of entry for aliens arriving by aircraft, (2) detail to such ports of entry such officers and employees of the immigration service as he may deem necessary, and to confer or impose upon any employee of the United States stationed at such port of entry (with the consent of the head of the Government department or other independent establishment under whose jurisdiction the officer or employee is serving) any of the powers, privileges, or duties conferred or imposed upon officers or employees of the immigration service, and (3) by regulation to provide for the application to civil air navigation of the laws and regulations relating to the administration of the immigration laws to such extent and upon such conditions as he deems necessary.

SEC. 8. ADDITIONAL ASSISTANT SECRETARY OF COMMERCE.—To aid the Secretary of Commerce in fostering air commerce and to perform such functions vested in the Secretary under this Act as the Secretary may designate there shall be an additional Assistant Secretary of Commerce, who shall be appointed by the President, by and with the advice and consent of the Senate, and whose compensation shall be fixed in accordance with the Classification Act of 1923. Except as otherwise specifically provided, the Secretary of Commerce shall administer the provisions of this Act and for such purpose is authorized (1) to make such regulations as are necessary to execute

the functions vested in him by this Act; (2) to make such expenditures (including expenditures for personal services and rent at the seat of government and elsewhere and for law books, books of reference, and periodicals) as may be necessary for such administration and as may be provided for by the Congress from time to time; (3) to publish from time to time a bulletin setting forth such matters relating to the functions vested in him by this Act as he deems advisable, including air navigation treaties, laws, and regulations and decisions thereunder; and (4) to operate, and for this purpose to acquire within the limits of the available appropriations hereafter made by the Congress, such aircraft and air navigation facilities, except airports, as are necessary for executing the functions vested in the Secretary of Commerce by this Act.

SEC. 9. DEFINITIONS.—As used in this Act—

(a) The term "citizen of the United States" means (1) an individual who is a citizen of the United States or its possessions, or (2) a partnership of which each member is an individual who is a citizen of the United States or its possessions, or (3) a corporation or association created or organized in the United States or under the law of the United States or of any State, Territory, or possession thereof, of which the president and two-thirds or more of the board of directors or other managing officers thereof, as the case may be, are individuals who are citizens of the United States or its possessions and in which at least 51 per centum of the voting interest is controlled by persons who are citizens of the United States or its possessions.

(b) The term "United States," when used in a geographical sense, means the territory comprising the several States, Territories, possessions, and the District of Columbia (including the territorial waters thereof), and the overlying airspace; but shall not include the Canal Zone.

(c) The term "aircraft" means any contrivance now known or hereafter invented, used, or designed for navigation of or flight in the air, except a parachute or other contrivance designed for such navigation but used primarily as safety equipment.

(d) The term "public aircraft" means an aircraft used exclusively in the governmental service.

(e) The term "civil aircraft" means any aircraft other than a public aircraft.

(f) The term "aircraft of the United States" means any aircraft registered under this Act.

(g) The term "airport" means any locality, either of water or land, which is adapted for the landing and taking off of aircraft and which provides facilities for shelter, supply, and repair of aircraft; or a place used regularly for receiving or discharging passengers or cargo by air.

(h) The term "emergency landing field" means any locality, either of water or land, which is adapted for the landing and taking off of aircraft, is located along an airway, and is intermediate to airports connected by the airway, but which is not equipped with facilities for shelter, supply, and repair of aircraft and is not used regularly for the receipt or discharge of passengers or cargo by air.

(i) The term "air navigation facility" includes any airport, emergency landing field, light or other signal structure, radio directional

finding facility, radio or other electrical communication facility, and any other structure or facility, used as an aid to air navigation.

(j) The term "civil airway" means a route in the navigable airspace designated by the Secretary of Commerce as a route suitable for interstate or foreign air commerce.

(k) The term "airman" means any individual (including the person in command and any pilot, mechanic, or member of the crew) who engages in the navigation of aircraft while under way, and any individual who is in charge of the inspection, overhauling, or repairing of aircraft.

SEC. 10. NAVIGABLE AIRSPACE.—As used in this Act, the term "navigable airspace" means airspace above the minimum safe altitudes of flight prescribed by the Secretary of Commerce under section 3, and such navigable airspace shall be subject to a public right of freedom of interstate and foreign air navigation in conformity with the requirements of this Act.

SEC. 11. PENALTIES.—(a) It shall be unlawful, except to the extent authorized or exempt under section 6—

(1) To navigate any aircraft within any airspace reservation otherwise than in conformity with the Executive orders regulating such reservation.

(2) To navigate any aircraft (other than a foreign aircraft) in interstate or foreign air commerce unless such aircraft is registered as an aircraft of the United States; or to navigate any foreign aircraft in the United States.

(3) To navigate any aircraft registered as an aircraft of the United States, or any foreign aircraft, without an aircraft certificate or in violation of the terms of any such certificate.

(4) To serve as an airman in connection with any aircraft registered as an aircraft of the United States, or any foreign aircraft, without an airman certificate or in violation of the terms of any such certificate.

(5) To navigate any aircraft otherwise than in conformity with the air traffic rules.

(b) Any person who (1) violates any provision of subdivision (a) of this section or any entry or clearance regulation made under section 7, or (2) any customs or public health regulation made under such section, or (3) any immigration regulation made under such section, shall be subject to a civil penalty of $500 which may be remitted or mitigated by the Secretary of Commerce, the Secretary of the Treasury, or the Secretary of Labor, respectively, in accordance with such proceedings as the Secretary shall by regulation prescribe. In case the violation is by the owner or person in command of the aircraft, the penalty shall be a lien against the aircraft. Any civil penalty imposed under this section may be collected by proceedings in personam against the person subject to the penalty and/or in case the penalty is a lien, by proceedings in rem against the aircraft. Such proceedings shall conform as nearly as may be to civil suits in admiralty; except that either party may demand trial by jury of any issue of fact, if the value in controversy exceeds $20, and facts so tried shall not be reexamined other than in accordance with the rules of the common law. The fact that in a libel in rem the seizure is made at a place not upon the high seas or navigable waters of the

United States, shall not be held in any way to limit the requirement of the conformity of the proceedings to civil suits in rem in admiralty. The Supreme Court of the United States, and under its direction other courts of the United States, are authorized to prescribe rules regulating such proceedings in any particular not provided by law. The determination under this section as to the remission or mitigation of a civil penalty imposed under this section shall be final. In case libel proceedings are pending at any time during the pendency of remission or mitigation proceedings, the Secretary shall give notice thereof to the United States attorney prosecuting the libel proceedings.

(c) Any aircraft subject to a lien for any civil penalty imposed under this section may be summarily seized by and placed in the custody of such persons as the appropriate Secretary may by regulation prescribe and a report of the case thereupon transmitted to the United States attorney for the judicial district in which the seizure is made. The United States attorney shall promptly institute proceedings for the enforcement of the lien or notify the Secretary of his failure so to act. The aircraft shall be released from such custody upon (1) payment of the penalty or so much thereof as is not remitted or mitigated, (2) seizure in pursuance of process of any court in proceedings in rem for enforcement of the lien, or notification by the United States attorney of failure to institute such proceedings, or (3) deposit of a bond in such amount and with such sureties as the Secretary may prescribe, conditioned upon the payment of the penalty or so much thereof as is not remitted or mitigated.

(d) Any person who fraudulently forges, counterfeits, alters, or falsely makes any certificate authorized to be issued under this Act, or knowingly uses or attempts to use any such fraudulent certificate shall be guilty of an offense punishable by a fine not exceeding $1,000 or by imprisonment not exceeding three years, or by both such fine and imprisonment.

(e) Any person (1) who, with intent to interfere with air navigation in the navigable airspace or waters of the United States, exhibits within the United States any false light or signal at such place or in such manner that it is likely to be mistaken for a true light or signal required by regulation under this Act, or for a true light or signal in connection with an airport or other air navigation facility, or (2) who, after due warning from the Secretary of Commerce continues to maintain any false light or signal, or (3) who knowingly removes, extinguishes, or interferes with the operation of any such true light or signal, or (4) who without lawful authority knowingly exhibits any such true light or signal, shall be guilty of an offense punishable by a fine not exceeding $5,000 or by imprisonment not exceeding five years, or by both such fine and imprisonment.

(f) All penalties paid under this Act shall be covered into the Treasury as miscellaneous receipts.

SEC. 12. SEPARABILITY.—If any provision of this Act is declared unconstitutional or the application thereof to any person or circumstance is held invalid, the validity of the remainder of the Act and the application of such provision to other persons and circumstances shall not be affected thereby.

SEC. 13. TIME OF TAKING EFFECT.—This Act shall take effect upon

its passage; except that no penalty shall be enforced for any violation thereof occurring within 90 days thereafter.

SEC. 14. SHORT TITLE.—This Act may be cited as the "Air Commerce Act of 1926."

1926—Joint Resolution of July 3, 1926 (44 Stat. L., 915)—Joint Resolution Authorizing the detail of officers of the Army Air Corps to duty with the Commerce Department in connection with the development of civil aviation.

That the President of the United States be, and he is hereby, authorized in his discretion to detail officers of the Air Corps of the Army of the United States to duty under the Secretary of Commerce in connection with the work of promoting civil aviation as provided for in the Air Commerce Act of 1926: *Provided*, That such detail shall not be for a period of more than one year.

1929—Act of January 25, 1929 (45 Stat. L., 1094, 116)—An Act Making appropriations for the Departments of State and Justice and for the Judiciary, and for the Departments of Commerce and Labor, for the fiscal year ending June 30, 1930, and for other purposes.

Aircraft in commerce: To carry out the provisions of the Act approved May 20, 1926, entitled "An Act to encourage and regulate the use of aircraft in commerce, and for other purposes" (U. S. C., pp. 2119-2123, secs. 171-184), including personal services in the District of Columbia (not to exceed $263,210) and elsewhere; rent in the District of Columbia and elsewhere; traveling expenses; contract stenographic reporting services; fees and mileage of witnesses; purchase of furniture and equipment; stationery and supplies, including medical supplies, typewriting, adding, and computing machines, accessories and repairs; maintenance, operation, and repair of motor-propelled passenger-carrying vehicles; purchase of not to exceed five airplanes, including accessories and spare parts, and maintenance, operation, and repair of airplanes, including accessories and spare parts; special clothing, wearing apparel, and similar equipment for aviation purposes; purchase of books of reference and periodicals; newspapers, reports, documents, plans, specifications, maps, manuscripts, and all other publications; and all other necessary expenses not included in the foregoing, $958,000.

Air-navigation facilities: For the establishment and maintenance of aids to air navigation, including the equipment of additional air-mail routes for day and night flying; the construction of necessary lighting, radio, and other signaling and communicating structures and apparatus; repairs, alterations, and all expenses of maintenance and operation; investigation, research, and experimentation to develop

and improve aids to air navigation; for personal services in the District of Columbia and elsewhere (not to exceed $82,540); purchase, maintenance, operation, and repair of motor-propelled, passenger-carrying vehicles, including their exchange; maintenance, operation, and repair of airplanes, including accessories and spare parts and special clothing, wearing apparel, and suitable equipment for aviation purposes; and for the acquisition of the necessary sites by lease or grant, $5,458,620: *Provided,* That no part of this appropriation shall be used for any purpose not authorized by the Air Commerce Act of 1926.

APPENDIX 5

FINANCIAL STATEMENT

Explanatory Note

Statements showing appropriations, receipts, expenditures, and other financial data for a series of years constitute the most effective single means of exhibiting the growth and development of a service. Due to the fact that Congress has adopted no uniform plan of appropriations for the several services and that the latter employ no uniform plan in respect to the recording and reporting of their receipts and expenditures, it is impossible to present data of this character according to any standard scheme of presentation. In the case of some services the administrative reports contain tables showing financial conditions and operations of the service in considerable detail; in others financial data are almost wholly lacking. Careful study has in all cases been made of such data as are available, and the effort has been made to present the results in such a form as will exhibit the financial operations of the services in the most effective way that circumstances permit.

The table herewith shows appropriations only. Under the laws relating to government appropriations expenditures may be made during the two years following the year to which the appropriation pertains, provided the obligation is incurred before the end of that year. In an organization like the Aeronautics Branch, which has extensive contractual obligations, many of the bills are not paid until after the end of the year. As the Aeronautics Branch has been operating for so short a period, the published statements of expenditures would have little significance.

The appropriation acts for the fiscal years 1928 and 1929 which were passed during the preceding fiscal years made certain amounts immediately available for expenditure in

order to expedite the work. These amounts are indicated in the footnotes to the table; thus, the part of an appropriation for the fiscal year 1928 available also in the fiscal year 1927 may be obligated during either the fiscal year 1927 or 1928.

APPROPRIATIONS
Fiscal Years 1927-30.

Fiscal Year	Aircraft in Commerce	Air Navigation Facilities
1927	$250,000	$300,000
1928	[a] 700,000	[b] 3,091,500
1929	[c] 885,850	[d] 4,689,550
1930	958,000	5,458,620

[a] $168,000 available also during fiscal year 1927.
[b] $450,000 available also during fiscal year 1927.
[c] $72,500 available also during fiscal year 1928.
[d] $1,000,000 available also during fiscal year 1928.

APPENDIX 6

BIBLIOGRAPHY[1]

Explanatory Note

The bibliographies appended to the several monographs aim to list only those works which deal directly with the services to which they relate, their history, activities, organization, methods of business, problems, etc. They are intended primarily to meet the needs of those persons who desire to make a further study of the services from an administrative standpoint. They thus do not include the titles of publications of the services themselves, except in so far as they treat of the services, their work and problems. Nor do they include books or articles dealing merely with technical features other than administrative of the work of the services. In a few cases explanatory notes have been appended where it was thought they would aid in making known the character or value of the publication to which they relate.

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